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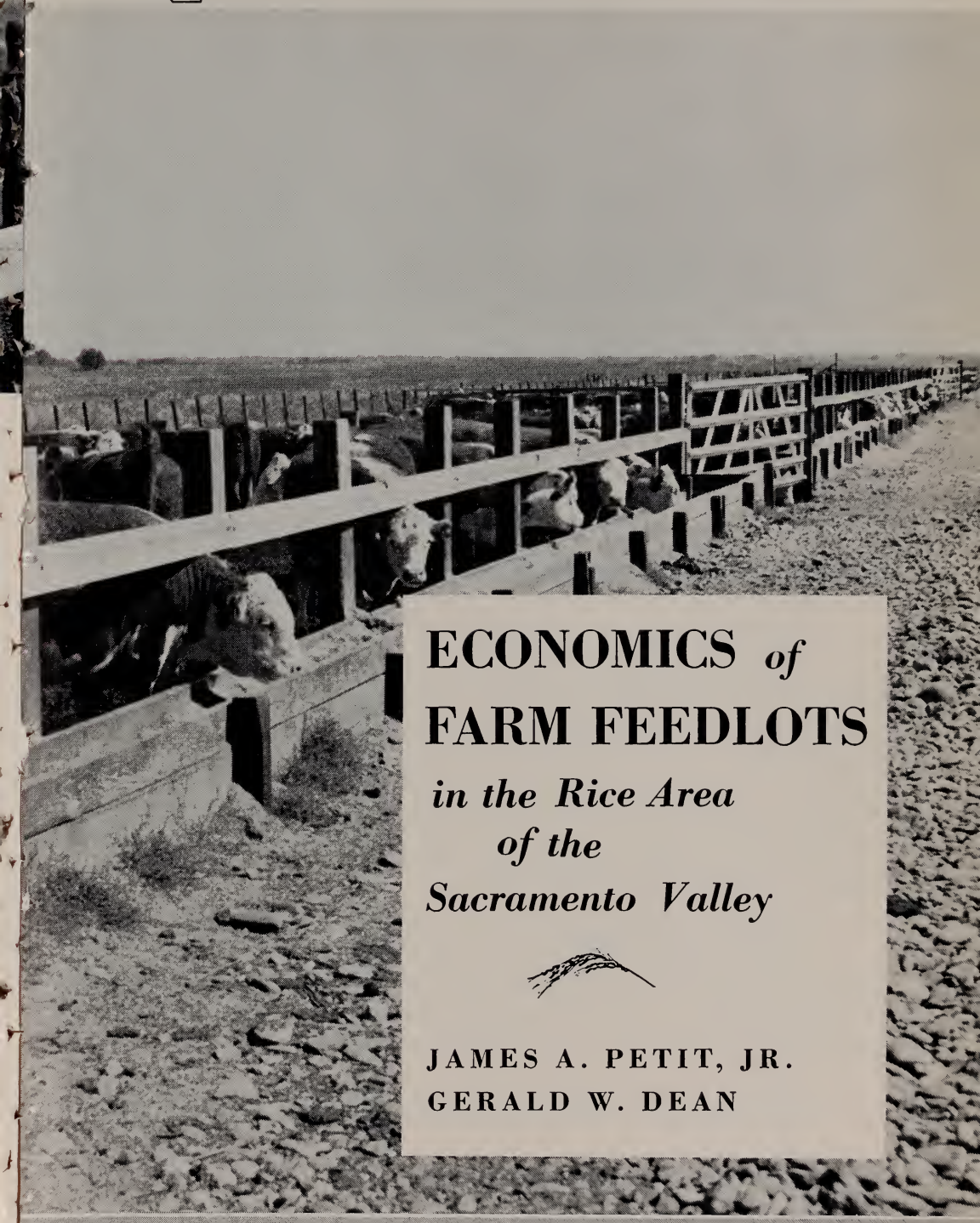

ECONOMICS *of* FARM FEEDLOTS

in the Rice Area of the Sacramento Valley

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CALIFORNIA AGRICULTURAL EXPERIMENT STATION

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The background: The heavy-soil areas of the Sacramento Valley are well adapted to the production of rice. This crop is usually most profitable and for this reason is grown here extensively. However, government controls on rice acreage have forced rice farmers to expand acreages of other crop alternatives, such as hay and grain. The question arises whether livestock feeding—and particularly drylot feeding of beef cattle—is economically feasible in this area.

This bulletin reports investigations of the economic feasibility of incorporating feedlots for beef cattle into the over-all organization of farms located in these heavy-soil areas of the Sacramento Valley. It specifically attempts to answer the following questions:

- What is the most profitable type of cropping system, and what are the income levels attainable for rice farms without livestock?
- What are the income possibilities available by adding various types of beef feedlot programs to rice farms?

- What type of ration is best suited for cattle feeding in this area? Are the most profitable rations high in forage (containing large proportions of silage and haylage), conventional alfalfa hay-grain rations, or all-concentrate rations?
- Which type of storage and feeding facilities best fit these situations? Should feeders with relatively small feedlots invest in a feedmill and feed conventional rations or invest in silos and feed rations high in silage?
- What are the risks and the critical variables which determine the success or failure of the cattle feeding systems studied?
- When a feedlot program is superimposed on a rice farm, should the cropping system be changed? Should the farm continue to produce rice and other cash crops and buy feeds, or revise its program to furnish the feeds required in the feedlot?

The main findings of the study are summarized on pages 1 and 2.

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ECONOMICS OF FARM FEEDLOTS

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Advantages and disadvantages

The heavy-soil areas of the Sacramento Valley hold the following advantages for beef-cattle feeding:

- Availability of surplus feed grains and alfalfa hay, now shipped out of this area; conversion of these feedstuffs to beef within the area would seem to be an alternative for farmers to consider.
- Availability of feeder cattle — from nearby foothill ranges during part of the year; from other parts of the West in any season.
- A large nearby market for the finished product because of the expanding population on the Pacific Coast.

The main disadvantage of the area for cattle feeding is the weather: Daytime summer temperatures are extremely high, sometimes reaching 110°–115°F, while winters tend to be damp and chilly. Essentially the entire annual rainfall, averaging about 18 inches, generally falls during a four-month period from December to March, accompanied by temperatures dropping occasionally to 15°–20°F. Because of mud and poor climatic conditions for feeding during the winter months, many feedlots in the Sacramento Valley are left vacant at this time.

Scope of study

An actual farming operation of about 1,000 acres was used to define the basic physical resources and the production possibilities considered. Linear programming was used to determine the most profitable crop and livestock programs and the income levels possible for this farm. Plans were developed (1) for a cash crop operation, (2) for operations including a farm feedlot of 1,500-head capacity, silos and silage handling equipment, and a choice of six rations using silage, and (3) for operations including the same 1,500-head feedlot, a feed mill and associated equipment, and a choice of four rations, including an all-concentrate ration (barley + supplement) and three other conventional grain-hay rations.

THE MAIN FINDINGS

The main findings of the study are:

- The cash crop farm alone (emphasizing rice production) provided an annual management income of about $10,000.
- Addition of the various types of cattle feeding programs increased potential management income to $40,000 to $80,000 per year.
- The most profitable nonsilage ration was all-concentrate (barley + supple-

[1] Submitted September 1962.

ment); the most profitable silage ration included alfalfa haylage, oats-vetch haylage, and barley. If percentage shrinks and final grades are assumed to be the same for these two rations, the cattle feeding programs based on them ranked almost equal in management income at approximately $80,000 a year. However, if the silage ration gives a higher percentage shrink and a lower percentage of finished cattle grading choice, the advantage of the higher concentrate ration can be substantial.

- In none of the situations analyzed was it profitable to attempt to grow all of the grain required to feed cattle; it was always more profitable to raise the maximum acreage of rice permitted by government allotments, sell the rice as a cash crop, and buy part of the grain fed.
- Incomes from the optimum plans including cattle feeding were very sensitive both to the level and the margin of cattle prices.
- If the optimum programs presented actually had been followed over the past 11 years, potential incomes would have been variable (ranging from about $50,000 to $200,000 annually) but in no case as low as from cash crop farming alone.
- The level of profits and the choice of the optimum rations also were quite sensitive to the daily gains specified. For example, the all-concentrate ration was most profitable only if gains obtained from it exceeded by at least 0.37 pounds per day those obtained from the optimum silage ration. More detailed discussion of these and other findings are presented in the text.

It must be recognized that these conclusions are based on near-peak efficiency as to crop yields, production costs, cattle feeding efficiency, death losses, and general operation of the farm business. In particular, not every farm operator is qualified to assume the managerial responsibilities which accompany an efficient feedlot operation. Special skills, aptitude, and judgment are especially important for buying and selling cattle at the most advantageous terms as to price, quality and uniformity, and maintaining cattle on feed and gaining at optimum rates throughout the feeding period. Therefore, the income levels shown from the livestock plans presented in this report are levels attainable under *superior* rather than *typical* management. However, for operators with sufficient capital and the managerial capacity to make the major shift from cash crops to a crop-livestock program, cattle feeding appears to be an alternative worthy of careful consideration in many parts of the rice area.

GENERAL PROCEDURE

The study farm of approximately 1,000 acres had been operated as a typical rice farm, with no livestock. This report accepts the land, irrigation facilities, and the basic crop machinery of the farm as *given* or *fixed* in the analyses to follow. However, two general alternative types of livestock feeding and storage systems are hypothetically superimposed on these basic ranch resources: (1) A 1,500-head capacity feedlot, 13 air-tight silos, specialized forage handling equipment and feeding equipment adapted to silage rations (rations with a high percentage of silage); and (2) a 1,500-head capacity feedlot, a feed mill and feeding equipment adapted to conventional types of hay-grain rations.

The report uses the following procedure: First, the basic resources of the study farm and the over-all assumptions of the report are discussed. Next, efficient

crop and livestock programs are determined for the basic resource situations, and income comparisons made among alternative plans. Finally, the plans including livestock are examined in detail to show the dependence of cattle feeding profits on price and gain relationships.

FIXED RESOURCES OF STUDY FARM

Land

The farm contains a net cropland acreage of 974 acres, composed of three grades of soils, designated as A, B and C. The A soil is medium-to-fine textured with good drainage and no alkali, well-adapted to a wide range of field crops. The predominant soil type is Marvin silty clay loam, with lesser amounts of Codora silty clay loam. The B soil also is Marvin silty clay loam, but contains some slight alkali deposits. The C soils are heavy textured, with a high water table, poor structure and alkali spots. These soils are composed of Marvin silty clay (slight alkali), Marvin silty clay loam (slight alkali), Sidds silty clay loam (slight alkali), and Quint silty clay (slight alkali). The A, B, and C soils total 209, 335, and 430 acres, respectively (a ratio of soil classes of 0.22 : 0.34 : 0.44). The land on the study farm is valued at an average of about $300 per acre. Table 1 shows the annual fixed costs associated with the land investment.

In evaluating the results of this study it is important to understand how the study farm compares in basic soil resources and cropping possibilities with other farms in the rice area (Sitton, 1958). In general, the study farm has a greater proportion of the higher-grade soils and therefore a wider range of cropping possibilities than is found in a large part of the rice area. Sitton (1958, pages 2–3) divides rice soils into three major natural divisions.

1. Alluvial fan and flood plain soils adjacent to rivers and streams. They are generally deep, permeable, well-drained, coarse-textured soils adapted to a wide range of crops. The A soils on the study farm are of this general type.
2. Basin soils in the bottom of the troughs. They are fine-textured, poorly-drained soils and more limited in cropping possibilities. The poorest of these soils are used only for rice or pasture. Others are adapted for wider use, including grain and forage. The B and C soils on the study farm are of this general type, but tending toward those with a wider range of crop possibilities.
3. Terrace soils lying between the rolling foothills and the flat basins. These soils are more variable than the above types, with crop uses ranging from nonirrigated pasture and grain to rice and irrigated forage crops. The study farm contains none of these soils.

Depending primarily on the combinations of these soils, the crops grown on specific rice farms may range from rice alone, to rotations of rice and other crops on the same fields, to combinations of rice and other crops not grown in the same fields. In a 1950 survey of 49 rice farms in Colusa County, Sitton (1958, pages 30–34) reports that 20 per cent of the farms produced rice only, 43 per cent produced rice and one or more small grains (mainly barley), 29 per cent produced rice, other grains and some other crop (usually alfalfa or ladino clover), and 6 per cent produced rice and alfalfa or ladino clover but no other grains. Other crops included oats and vetch, barley and vetch, milo, and sudan grass for seed. While cropping

Table 1

CAPITAL INVESTMENT AND ASSOCIATED ANNUAL FIXED COSTS FOR CASH CROP FARM

Item	Initial cost	Estimated useful life	Average investment*	Annual depreciation†	Taxes and insurance‡	Interest on investment§
	dollars	years	dollars			
Land (1,018 acres at $300)	305,500				3,055	18,330
Buildings						
2 Implement sheds	10,000	20	5,000	500	100	350
Foreman's house	15,300	20	7,650	765	153	536
Machine shed	3,000	20	1,500	150	30	105
Total buildings	28,300		14,150	1,415	283	990
Irrigation equipment						
Well and pump	1,625	10	812	162	16	57
2 pumps	6,100	10	3,050	610	61	214
Total irrigation equipment	7,725		3,862	772	77	270
Ranch vehicles						
Pickup (used)	1,000	5	500	200	10	35
Pickup	2,200	5	1,100	440	22	77
Jeep	1,600	5	800	320	16	56
Bankout wagon	1,000	10	500	100	10	35
2 ton truck	3,400	10	1,700	340	34	119
1½ ton truck	3,200	10	1,600	320	32	112
Total ranch vehicles	12,400		6,200	1,720	124	434
Cultural equipment						
115 HP tracklayer	25,000	15	12,500	1,667	250	875
75 HP tracklayer	14,700	15	7,350	980	147	514
2 50-HP tracklayer	17,200	15	8,600	1,147	172	602
45 HP diesel-wheel	6,000	10	3,000	600	60	210
40 HP diesel-wheel	5,300	10	2,650	530	53	186
2 25-HP gas-wheel	4,000	10	2,000	400	40	140
Landplane 14′ × 60′	3,600	20	1,800	180	36	126
5 sections of harrow and heavy duty drawbar	350	10	175	35	4	12
2 tillers	1,000	10	500	100	10	35
2 bottom plow	450	10	225	45	4	16
2-way plow (4 bottom)	4,000	10	2,000	400	40	140
20′ springtooth harrow	630	10	315	63	6	22
30′ spiketooth harrow	320	10	160	32	3	11
2 12′ disc harrows	2,800	10	1,400	280	28	98
15′ disc harrow	2,000	10	1,000	200	20	70
8′ seeder	900	10	450	90	9	32
6-row planter	900	10	450	90	9	32
4-row planter	600	10	300	60	6	21
6-row cultivator	1,000	10	500	100	10	35
Ditcher	800	10	400	80	8	28
Ridger	500	10	250	50	5	18
Side-delivery rake	700	10	350	70	7	24
Rear-mounted mower	185	10	92	18	2	6
Baler	1,120	10	560	112	11	39
Bale loader	225	10	112	22	2	8
150-gal. sprayer	2,500	10	1,250	250	25	88
Total cultural equipment	96,780		48,390	7,601	968	3,387
Miscellaneous						
Office equipment	1,400	10	700	140	14	49
Desk and file	200	10	100	20	2	7
Total miscellaneous	1,600		800	160	16	56
Grand total	452,305		73,402	11,669	4,523	23,468

* Computed assuming no salvage value. † Straight-line method. ‡ Figured at 1 per cent of original cost.
§ Seven per cent of average investment except land. Land figured at 6 per cent of initial cost.
Note: Occasional discrepancy in final digit from rounding original computations to nearest dollar.

systems in the area undoubtedly have changed in the past ten years, such as the introduction of safflower as a major crop, this survey indicates that the cropping possibilities on a large proportion of rice farms undoubtedly are more restricted than on the study farm. The cropping systems, livestock programs and income levels reported in this study reflect this fact and should be so interpreted.

Irrigation facilities

Approximately 544 acres on the study farm are irrigated by surface water from the irrigation district, the remainder being serviced from wells located on the farm. As in other parts of the rice area, water from the district is relatively inexpensive, costing a flat $11.00 per acre for rice and $1.50 per acre-foot for other crops. The variable cost of pumping water for the remainder of the farm is low because of the high water table, and also is assumed to equal $1.50 per acre-foot.

The investment and annual fixed costs associated with the irrigation system on the study farm are detailed in table 1, along with the other investment items for a cash crop operation.

Machinery, buildings, equipment

Cash crop farm. Table 1 gives the description, investment, and annual fixed costs of the land, buildings, irrigation equipment, and machinery used primarily for cash crop production on the study farm. This list corresponds closely to the expected inventory on a rice farm which contracts rice harvesting, raises no livestock, and sells all crops.

Crop-livestock farm using silage rations. Expanding a cash crop operation to include a farm feedlot operation utilizing silage rations requires certain changes in machinery and facilities (see table 2). The specialized equipment for baling hay is deleted from the machinery inventory and replaced by additional forage handling equipment for bringing the forage from the fields and blowing it into the silos. A 1,500-head capacity[2] feedlot and 13 air-tight silos constitute the major investment items in converting from the cash crop to the farm feedlot-silage operation. The feedlot costs are high because the entire lot is concreted to permit year-around feeding; heavy winter rains and poor natural drainage necessitate this step. The silos, with a capacity of about 170 tons of forage each, are located near the feedlot. They can be used for moist as well as dry grain and for silage or haylage—a green chop which is field-wilted to 40–50 per cent moisture and then ensiled.

The feedlot is designed for feeding by automatic unloading trucks, which are loaded by an auger conveyor from the silos. Ingredients of the rations are delivered automatically from the respective silos into a central auger, where the ration is mixed and delivered to the truck. Proportions of ingredients for the various rations are controlled by varying the unloading time for the particular components; the truck itself rests on a scale permitting control of the total quantity of a ration fed to each pen. The feeding operation is highly mechanized, requiring only one man to feed the 1,500-head lot.

Despite the large investment in silos, some of the rations studied require more silage during the winter months than can be stored. To permit year-around feeding, it is possible to buy baled alfalfa hay and "reconstitute" it to haylage by chopping it, adding water to bring the moisture level up to haylage content, and blowing it into the silo. This process permits year-around feeding on haylage without restricting livestock numbers because of limited storage capacity or quantity of home-grown haylage. However, because

[2] The 1,500-head figure is a "practical" capacity taking into account the unavoidable delays and time lapses between lots of cattle. At any given time the physical capacity of the lot is slightly over 1,700 head.

Table 2

ADDITIONS AND DELETIONS OF MACHINERY AND FACILITIES FOR CONVERTING FROM CASH CROP OPERATION TO FARM FEEDLOT, SILAGE RATIONS

Item	Initial cost	Estimated useful life	Average investment*	Annual depreciation†	Taxes and insurance‡	Interest on investment§
	dollars	years	dollars			
Delete						
Rear-mounted mower	185	10	92	18	2	6
Side-delivery rake	700	10	350	70	7	24
Baler	1,120	10	560	112	11	39
Bale loader	225	10	112	22	2	8
Total deletions	2,230		1,115	223	22	78
Add						
Livestock equipment and facilities						
Feedlot, wiring, plumbing and 2 scales	90,000	20	45,000	4,500	900	3,150
13 air-tight silos	157,274	20	78,637	7,864	1,573	5,505
3 forage unloaders	5,250	10	2,625	525	52	184
2 grain unloaders	3,850	10	1,925	385	38	135
Crimper	1,200	10	600	120	12	42
Auger	3,000	10	1,500	300	30	105
Squeeze	500	10	250	50	5	18
3 trucks	10,200	10	5,100	1,020	102	357
4 feeder kits	6,531	10	3,266	653	65	229
Total	277,805		138,902	15,417	2,778	9,723
Cultural equipment						
Swather (14′)	4,705	10	2,352	470	47	165
Forage chopper	8,154	10	4,077	815	82	285
Accessories for chopper	2,294	10	1,147	229	23	80
Blower	885	10	442	88	9	31
Total	16,038		8,019	1,604	160	561
Total additions	293,843		146,922	17,021	2,938	10,285
Net additions	291,613		145,806	16,798	2,916	10,206

* Computed assuming no salvage value.
† Straight-line method.
‡ Figured at 1 per cent of original cost.
§ Seven per cent of average investment.
Note: Occasional discrepancy in final digit from rounding original computations to nearest dollar.

the quality of reconstituted haylage is lower than haylage harvested directly, the two forages should be blended for late-winter feeding.

Crop-livestock farm using non-silage rations. In addition to the basic machinery in table 1, a feedlot operation using conventional grain-hay rations requires the machinery and facilities listed in table 3 (see also King, 1962). Of course, the required amount of hay storage and handling facilities varies depending on the ration fed. The investment in table 3 provides sufficient hay storage for a daily ration including up to eight pounds of hay per head. An all-concen-

Table 3

ADDITIONS OF MACHINERY AND FACILITIES FOR CONVERTING FARM CASH CROP OPERATION TO FARM FEEDLOT, NONSILAGE RATIONS

Item	Initial cost	Estimated useful life	Average investment*	Annual depreciation†	Taxes and insurance‡	Interest on investment§
	dollars	years	dollars			
Add						
Livestock equipment and facilities						
Feedlot, wiring, plumbing, 2 scales	90,000	20	45,000	4,500	900	3,150
Feed mill and storage facilities	77,120	20	38,560	3,856	771	2,699
Components for all-concentrate rations	(53,150)	(20)	(26,575)	(2,658)	(532)	(1,860)
Additional components for rations using alfalfa-hay‖	(23,970)	(20)	(11,985)	(1,198)	(240)	(839)
Squeeze	500	10	250	50	5	18
Self-unloading feeder kit	1,633	10	816	163	16	57
Net additions	169,253		84,626	8,569	1,693	5,924

* Computed assuming no salvage value.
† Straight-line method.
‡ Figured at 1 per cent of initial cost.
§ Seven per cent of average investment.
‖ Assumes sufficient hay storage facilities for daily rations including up to 8 pounds of alfalfa-hay per head for a 1500-head capacity feedlot. For additional details on feed mill costs see: King (1962).
Note: Occasional discrepancy in final digit from rounding original computations to nearest dollar.

trate ration could eliminate hay handling facilities and reduce the initial cost by approximately $24,000. The corresponding corrections in annual fixed costs are made in later comparisons of incomes among plans. The feed-mill operation represents a typical layout and feeding procedure for a feedlot with a small mill. It takes about three men to run the mill and feed the cattle on the conventional hay-grain rations, but only two men for the all-concentrate ration since there is no hay to handle. Before mixing, the hay component of the rations is unbaled and ground in a hay mill, and the grain is rolled. The mixed feed can be stored in feed bins or loaded directly on the feeding truck. The truck is self-unloading so that feeding is accomplished by driving along the bunkers.

Labor, management, and capital

The full-time labor and management force on the ranch consists of a manager-owner and a crop foreman. The crop foreman supervises field crews and keeps time cards on the labor and machinery inputs to different crops and fields. Costs are summarized and other records and accounts are kept by a bookkeeper working about one-half time. When the feedlot is added, additional men are needed year-around for feeding. As mentioned above, the silage programs require one man for feeding while the feed mill programs require three for this purpose. The manager-owner devotes the major portion of his time to the cattle operation, particularly in buying and selling cattle, buying feeds and specifying the rations to be fed. The manager, together with the men doing the feeding, also watches for sickness, for cattle off feed, and helps to sort and treat animals. However, many feedlots of this size hire an additional man strictly for handling cattle (exclusive of feeding) ; in this case, the income figures reported later would be lowered by about $5,000 per year. All full-time employees are salaried except the owner-manager who receives his compensation from profits. The remaining labor for crop and

livestock production on the farm is hired seasonally at prevailing rates in the area.

It is assumed that the operation has the management and financial backing to warrant obtaining ample operating capital or investment capital for any of the plans envisioned in this report. It is further assumed that that the owner-manager has 100 per cent equity in the land, machinery, and feeding facilities, but borrows operating capital to finance the crop production and cattle inventory. Of course, financial conditions vary widely from situation to situation and may require corresponding adjustments in the costs and returns shown later. For example, if investment capital for the feedlot construction and silos must be borrowed, the interest paid would be a cash fixed cost rather than noncash "interest on investment." (Such adjustments could be made directly from the data in appendix table A-11.)

Cost comparisons

Table 4 itemizes the major categories of fixed costs associated with the various farming programs analyzed in this report. The bottom portion of table 4 gives the total fixed costs for each of the three major situations studied. The fixed costs for the plans including livestock are obviously considerably higher than for the cash crop operation. Fixed costs for the silage operation are $5,734 higher than those for the conventional ration operation; although labor costs for the silage operation are $8,000 lower than

Table 4

SUMMARY OF FIXED COSTS FOR ENTIRE FARM, OPERATED AS CASH CROP FARM, FARM FEEDLOT WITH SILOS, AND FARM FEEDLOT WITH FEEDMILL

Item	Depreciation	Taxes and insurance	Interest on investment	Miscellaneous cash fixed costs	Total annual fixed costs
	dollars				
1. Land (table 1)	.....	3,055	18,330	.....	21,385
2. Buildings (table 1)	1,415	283	990	.....	2,688
3. Irrigation equipment (table 1)	772	77	270	.....	1,120
4. Cash-crop machinery and facilities (table 1)	9,481	1,108	3,877	.....	14,466
5. Additional machinery and equipment for silage rations (table 2)	16,798	2,916	10,206	.....	29,920
6. Additional machinery and equipment for non-silage rations (table 3)	8,569	1,693	5,924	.....	16,186
7. Bookkeeping and overhead (Accountant plus misc. off. exp.)	.....	.....	.....	5,200	5,200
8. Crop foreman (Annual salary)	.....	.....	.....	5,000	5,000
9. Feeding labor, silo operation (One man, annual salary)	.....	.....	.....	5,000	5,000
10. Feeding labor, feedmill operation (3 men, annual salaries)	.....	.....	.....	13,000	13,000
11. Total fixed costs for cash-crop farm (sum of items 1, 2, 3, 4, 7, 8)	11,669	4,523	23,468	10,200	49,860
12. Total fixed costs for farm plus feedlot with silo operation (sum of items 1, 2, 3, 4, 5, 7, 8, 9)	28,466	7,439	33,675	15,200	84,780
13. Total fixed costs for farm plus feedlot with feedmill operation (sum of items 1, 2, 3, 4, 6, 7, 8, 10)	20,238	6,216	29,392	23,200	79,046

Note: Occasional discrepancy in final digit from rounding original computations to nearest dollar.

for the conventional ration operation, the annual fixed costs associated with the investment in the silage operation are $13,692 higher ($13,734–$8,000=$5,734). Thus, the annual fixed costs of the conventional and the silage programs are quite comparable. The comparative advantage of the two systems therefore is likely to hinge on factors other than annual overhead costs.

CROP AND LIVESTOCK ALTERNATIVES CONSIDERED

Cropping alternatives

Each of the three soil groups on the study farm is physically adapted to a range of crops. Table 5 summarizes yields, costs and returns, by soil group, for each crop alternative considered. While certain high-income cash crops, such as tomatoes and sugar beets, might be grown on parts of the A soil on the ranch, the range of crops considered is limited to those more typically grown in the rice area. Yields were estimated in consultation with Farm Advisor personnel familiar with the area, and checked against county yield records and crop history on the study farm.[3] Production costs for each crop were estimated by updating and revising past cost studies of Farm Advisors, and comparing these with production costs on the study ranch (appendix tables A-1 to A-10). Since haylage and silage are used directly on the farm and have no established sale value, prices and returns are not computed for these alternatives in table 5. In the plans presented later, these activities contribute toward total profits through the livestock feeding opportunities they permit.

Livestock alternatives

To find the most profitable feeding program for a number of situations, ten different rations were considered, ranging from an all-concentrate ration to rations high in silage and haylage. A major problem was encountered in establishing daily gains for each of these rations. While results from a large number of individual feeding trials were available, the experimental conditions from trial to trial varied greatly as to type and breed of animal, weighing conditions, climatic conditions, control rations, and other factors. Therefore, to estimate gains more directly comparable among rations, the relationship in equation (1), derived experimentally by Garrett *et al.* (1959) was used:

(1) $TDN = 0.0331\ W^{0.75}\ (1.48)^{G}$

where TDN = pounds of total digestible nutrients fed per day. (Concentrates are entered in the equation at 100 per cent of their TDN value; good quality roughage at 75 per cent of reported TDN, and poor quality roughage at 50 per cent of reported TDN.)

W = weight of the animal in pounds

G = gain in pounds per day

The daily requirements for feeder cattle were taken from Morrison (1949). Tables 6 and 7 give these requirements, the composition of feeds, and the components of the ten rations considered, along with estimated gains per day based on equation (1). The resultant gains, varying from 2.37 to 2.87 pounds per day probably should be considered close to the maximum attainable under actual feeding conditions on a year-around basis. Many feeders will not be able to obtain the gain levels specified in table 7 under normal day-to-day conditions. For example, in a study based on a survey of 85 feedlot operators, Hopkin (1957, page 24) reports average gains in California

[3] F. L. Bell, and Robert Sailsbery, Glenn County farm advisors, were particularly helpful in suggesting appropriate crop yield levels for the various soils.

Table 5

SUMMARY OF PRICES AND YIELDS, COSTS, AND RETURNS PER ACRE FOR CROP ALTERNATIVES

Crop	Unit	Price per unit	Yields, costs and returns per acre								
			Soil A*			Soil B*			Soil C*		
			Yield†	Variable cost‡	Net return	Yield†	Variable cost‡	Net return	Yield†	Variable cost‡	Net return
		dollars	units/acre	dollars		units/acre	dollars		units/acre	dollars	
Alfalfa hay	ton	22.00	8	79.50	96.48	6	76.98	55.02	4	74.36	13.64
Alfalfa haylage§	ton	....	15	68.40	....	11	64.35	....	7	60.55	....
Barley	cwt.	1.85	30	27.60	27.90	22	25.74	14.96	15	24.00	3.75
Pink beans	cwt.	6.50	20	86.00	44.00	....	....	....	....	....	....
Corn (grain)	cwt.	2.35	55	66.55	62.70	....	....	....	....	....	....
Corn (silage)§	ton	....	25	75.25	....	....	....	....	....	....	....
Milo	cwt.	2.00	55	45.42	64.58	42	45.42	38.58	35	45.42	24.58
Oat-vetch haylage§	ton	....	6	28.92	....	5	27.85	....	4	26.96	....
Rice	cwt.	4.25	55	110.55	123.20	40	102.00	68.00	30	96.60	30.90
Safflower	cwt.	3.75	22	38.94	43.56	15	37.50	18.75	....	....	....
Barley (double-cropped)	cwt.	1.85	30	73.02	92.48	22	71.16	53.54	15	69.42	28.33
Milo (double-cropped)	cwt.	2.00	55			42			35		
Oat-vetch§ (double-cropped)	ton	....	6	74.34	35.66	5	73.27	10.73	4	72.38	−2.38
Milo (double-cropped)	cwt.	2.00	55			42			35		
Barley (double-cropped)	cwt.	1.85	30	113.60	71.90	....	....	....	....	....	....
Pink beans (double-cropped)	cwt.	6.50	20			....	....	....	....	....	....

* See page 3.
† Based on estimates by Glenn County Farm Advisors, county yield records and crop history on study farm.
‡ Based on Farm Advisor cost studies, updated and adjusted to current equipment and farm wage rates. (See appendix tables A-1 to A-11.)
§ Haylage and silage used directly for feeding; nonsaleable.

Table 6

FATTENING REQUIREMENTS AND COMPOSITION OF FEEDS

	Dry matter	Digestible protein	TDN	Calcium	Phosphorus	Carotene	Estimated net energy
	pounds/day					mg/day	therms/day
Requirements for fattening yearling cattle (800 pounds)	17.8–20.4	1.5–1.7	14.1–15.9	.044	.042	45	13.0–14.6
Composition of feeds	per cent					mg/pound	therms/cwt
Concentrates							
Barley	89.9	6.9	78.8	0.06	0.33	0.2	71.4
Milo	88.0	8.2	78.5	0.02	0.32	....	76.4
#2 Dent corn	85.0	6.6	80.1	0.02	0.27	2.2	80.1
Beet pulp	92.2	5.9	72.4	0.57	0.07	0.1	74.3
U.C. supplement*	79.5	23.4	58.3	3.20	0.66	8.7	57.2
Roughage							
Alfalfa hay	90.5	11.2	51.4	1.47	0.24	8.2	41.5
Alfalfa haylage	60.0	7.1	35.7	0.84	0.17	18.9	29.1
Oat-vetch haylage	60.0	3.4	35.0	....	....	40.2	29.8
Corn silage	26.3	1.1	17.2	0.09	0.06	5.8	16.3

* U.C. supplement = 57 per cent cottonseed meal
20 per cent alfalfa meal
10 per cent molasses
7 per cent ground limestone
6 per cent trace mineralized salt

Source: Morrison (1949).

feedlots ranging from only 1.86 to 2.13 pounds per day for 600-pound steers, and 2.08 to 2.33 pounds per day for 900-pound steers. Thus, the income figures derived from cattle feeding as shown in this report should be interpreted as nearing the upper limit attainable by the most efficient managers. The importance of gains per day on the level of income attainable is discussed in more detail on page 26.

Table 8 summarizes the gross return minus purchase cost per head for cattle fed on each of the ten rations. The higher concentrate rations naturally show greater returns when so computed because of greater weight gains. However, one purpose of this study is to find which rations are more profitable when livestock feeding is considered as one component in an over-all farming program.

The feeder cattle are bought as 600-pound good-to-choice feeders, fed 150 days and sold at 922 to 995 pounds, depending on the ration fed. These marketing weights represent actual weight sold after deducting a 3½ per cent shrink on the gross weight. (Data based on Wyckoff, 1961.) The gains presented in table 7 are gains in the lot before shrink is deducted. It is also assumed that differences among rations in finishing grade are negligible—that 75 per cent of the cattle finish choice and 25 per cent good for each ration. These assumptions probably are unduly favorable to the higher roughage rations relative to higher concentrate rations. It is likely that cattle fed on the former will have a higher percentage shrink and place a smaller percentage of animals in the choice grade as compared with cattle fed on the latter. As data were not available to specify with precision the differences among rations for these factors, the same assumptions were used for all. However, the effects on comparative incomes

Table 7

DAILY RATIONS, COMPOSITION AND GAIN PER DAY*

Ration components	Amount	Dry matter	Digestible protein	TDN	Calcium	Phosphorus	Carotene	Net energy	Gain per day†
	pounds						mgms.	therms	pounds
Ration #1									
Barley	18.0	16.2	1.2	14.2	0.012	0.059	3.6	12.8	
U.C. supplement	2.0	1.6	0.5	1.2	0.063	0.013	17.4	1.1	
Total	20.0	17.8	1.7	15.4	0.075	0.072	21.0	13.9	2.87
Ration #2‡									
Alfalfa hay	2.0	1.8	0.2	1.0	0.029	0.005	16.4	0.8	
Barley	13.0	11.7	0.9	10.3	0.008	0.043	2.6	9.3	
Beet pulp	6.0	5.5	0.4	4.3	0.034	0.004	0.6	4.4	
Total	21.0	19.0	1.5	15.6	0.071	0.052	19.6	14.5	2.87
Ration #3									
Alfalfa hay	5.7	5.2	0.6	2.9	0.084	0.014	46.7	2.4	
Barley	12.0	10.8	0.8	9.5	0.007	0.040	2.4	8.6	
Beet pulp	4.9	4.5	0.3	3.6	0.028	0.003	0.5	3.6	
Total	22.6	20.5	1.7	16.0	0.119	0.057	49.6	14.6	2.85
Ration #4									
Alfalfa hay	8.0	7.2	0.9	4.1	0.118	0.019	65.6	3.3	
Barley	9.8	8.8	0.7	7.7	0.006	0.032	2.0	7.0	
Beet pulp	4.2	3.9	0.2	3.0	0.024	0.003	0.4	3.1	
Total	22.0	19.9	1.8	14.8	0.148	0.054	68.0	13.4	2.61
Ration #5									
Alfalfa haylage	16.0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Oat-vetch haylage	4.0	2.4	0.1	1.4	.....	.....	160.8	1.2	
Barley	10.0	9.0	0.7	7.9	0.006	0.033	2.0	7.1	
Total	30.0	21.0	1.9	15.0	0.140	0.060	465.2	13.0	2.49

Ration #6									
Alfalfa haylage	16 0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Oat-vetch haylage	4.0	2.4	0.1	1.4	.....	.....	160.8	1.2	
Milo	10.0	8.8	0.8	7.8	0.002	0.032	.....	7.6	
Total	30.0	20.8	2.0	14.9	0.136	0.059	463.2	13.5	2.47
Ration #7									
Alfalfa haylage	16.0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Oat-vetch haylage	4.0	2.4	0.1	1.4	.....	.....	160.8	1.2	
Corn	10.0	8.5	0.7	8.0	0.002	0.027	22.0	8.0	
Total	30.0	20.5	1.9	15.1	0.136	0.054	485.2	13.9	2.51
Ration #8									
Alfalfa haylage	16.0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Corn silage	4.0	1.0	0.1	0.7	0.004	0.002	23.2	0.6	
Barley	10.0	9.0	0.7	7.9	0.006	0.033	2.0	7.1	
Total	30.0	19.6	1.9	14.3	0.144	0.062	327.6	12.4	2.39
Ration #9									
Alfalfa haylage	16.0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Corn silage	4.0	1.0	0.1	0.7	0.004	0.002	23.2	0.6	
Milo	10.0	8.8	0.8	7.8	0.002	0.032	.....	7.6	
Total	30.0	19.4	2.0	14.2	0.140	0.061	325.6	12.9	2.37
Ration #10									
Alfalfa haylage	16.0	9.6	1.1	5.7	0.134	0.027	302.4	4.7	
Corn silage	4.0	1.0	0.1	0.7	0.004	0.002	23.2	0.6	
Corn	10.0	8.5	0.7	8.0	0.002	0.027	22.0	8.0	
Total	30 0	19.1	1.9	14.4	0.140	0.056	347.6	13.3	2.41

* All rations balanced to meet requirements for fattening yearling cattle specified in table 6.
† Gains estimated by procedure described on page 9.
‡ Needs a small amount of carotene to meet requirements.

Table 8

PURCHASE COST, GROSS RETURN AND GROSS RETURN MINUS PURCHASE COST PER HEAD FOR CATTLE FED FOR EACH OF THE TEN RATIONS

Ration number	Purchase cost			Gross return			Gross return minus purchase cost
	Average weight	Average price per cwt*	Average cost	Average weight†	Average price per cwt‡	Average gross return§	
	pounds	dollars		pounds	dollars		
1	600.0	25.00	150.00	994.4	25.375	252.33	102.33
2	600.0	25.00	150.00	994.4	25.375	252.33	102.33
3	600.0	25.00	150.00	991.5	25.375	251.59	101.59
4	600.0	25.00	150.00	956.8	25.375	242.79	92.79
5	600.0	25.00	150.00	939.4	25.375	238.37	88.37
6	600.0	25.00	150.00	936.5	25.375	237.64	87.64
7	600.0	25.00	150.00	942.3	25.375	239.11	89.11
8	600.0	25.00	150.00	925.0	25.375	234.72	84.72
9	600.0	25.00	150.00	922.0	25.375	233.96	83.96
10	600.0	25.00	150.00	927.8	25.375	235.43	85.43

* Assume purchase 50 per cent choice and 50 per cent good with choice at $25.75/cwt and good at $24.25/cwt giving an average price/cwt of $25.00.

† 150-day average feeding period. Gains per day are shown in table 7. Weight shown is after a 3½ per cent shrink has been deducted.

‡ Assume finish 75 per cent choice and 25 per cent good with choice at $25.75/cwt and good at $24.25/cwt giving an average price/cwt of $25.375.

§ Death loss assumed to be negligible.

of varying percentage shrinks and final grades are discussed on page 31.

It also was assumed that death losses for cattle on all of the rations were negligible. However, differences in death losses among rations might be a factor in choice of ration. For example, with the feedlot at a capacity of 3,600 head per year, a 1 per cent death loss would reduce gross and net incomes by about $7,000 per year.

For the major part of the analysis, a zero price margin is assumed—good-choice cattle are bought and sold at an average price of 25 cents per pound. (However, average sale price slightly exceeds purchase price because of a larger percentage in the choice grade, table 8.) In essence, this implies that there is no within-year trend or cycle in cattle prices. The effect of different sets of price relationships is analyzed later in more detail.

METHOD OF ANALYSIS

Given the large number of crop and livestock alternatives presented, linear programming (Heady and Candler, 1958) is used to evaluate the profitability of the large number of combinations possible. Linear programming is a mathematical technique which selects the most profitable combination of activities from those available, consistent with resources available, government programs, and other restrictions. First, the cost and net return from each of the crop and livestock alternatives is budgeted (see the text and appendix tables for crop and livestock budgets). Then, the resource restrictions are specified. In this study, the major restricting resources are the acreage of total farmland, acreage of land in each soil class, rice allotment, maximum acreage of land doublecropped (no more than 50 per

cent of each soil type), feedlot capacity by months (1,500-head "practical" capacity), and silo storage space.[4] Finally, given these alternatives and restrictions, the linear programming procedure selects the most profitable plan. (Problems solved on the IBM 704 computer.) By changing the alternatives, restrictions, prices and other data, solutions to a range of situations can be obtained.

OPTIMUM CROPPING SYSTEM AND INCOME WITHOUT LIVESTOCK

Table 9 presents the most profitable cropping system and the resulting level of income for the study ranch when operated as a cash crop farm with no livestock—the typical type of operation in the rice area. The results serve as a point of comparison with later analyses which convert the operation to alternative types of farm-feedlot programs. Rice is the most profitable cash crop on each soil group. However, the 309-acre rice allotment is most profitably planted on the better soils; all of the A soils (209 acres) and 100 acres of the B soils are allocated to rice.[5] The remainder of the B soil (235 acres) is planted to alfalfa, the next most profitable cash crop on B soils. Aside from rice, barley × milo (doublecropped) is the most profitable cash crop on C soils. Since doublecropping is limited to 50 per cent of the acreage, 215 acres of C soil are planted to barley × milo (doublecropped) and the remaining C acreage is planted to milo, the next ranking crop in profitability.

The bottom portion of table 9 sum-

Table 9

OPTIMUM CROPPING SYSTEM AND INCOME LEVEL WITHOUT LIVESTOCK

Category	Crop	Acres
Crops		
Soil A	Rice	209
Soil B	Rice	100
	Alfalfa hay	235
Soil C	Barley × milo (doublecropped)	215
	Milo	215
	dollars	
Costs and returns		
Gross income	132,940	
Cash variable costs	76,086	
Cash fixed costs	12,186	
Depreciation	11,669	
Interest on investment	23,468	
	dollars	
Net income		
Net cash income*	44,668	
Net farm income	32,999	
Management income	9,531	

* See definitions on page 16.

[4] Silo storage space is most limiting at the end of the summer when alfalfa haylage harvest is completed. Two silos are set aside for grain and the remaining eleven (total capacity = 1,870 tons haylage) are available for silage. The cattle on feed during the summer eat the silage component of the ration after it has been allowed to process in the tanks—a period of approximately two weeks after harvest. The excess supply harvested accumulates through the summer, reaching a peak with the last cutting of alfalfa. If enough silage cannot be stored to carry the 1,500 head of cattle through the winter, either hay must be purchased and reconstituted, cattle numbers reduced, or a different ration fed.

[5] Putting all of the A soils into rice assumes that continuous rice is possible. While continuous rice is not typical, some fields in the study area have maintained or increased rice yields when continuously cropped with rice over a 15-year period. More typically land is planted to rice for 3–5 years, then fallowed or planted to a nonirrigated crop for a year, followed by safflower, milo, bean, oats-vetch or some other alternative for a year, and then returned to rice. If continuous rice is not considered practical, the cropping system in table 9 could be revised to combine A and B soils into one rotation, with a maximum of 4 years of rice followed by 3 years in alfalfa. Such a revision would reduce management income by only about $1,000 from that shown in table 9.

Net cash income = gross income minus cash variable costs minus cash fixed costs. This figure gives the cash remaining from the business after paying all cash expenses for the year. Unless this figure is positive, the operator will be forced to draw on savings or outside sources of funds to continue in operation, even in the short run.

Net farm income = net cash income minus depreciation. If this figure is positive, the operator can stay in business indefinitely. He can replace his equipment, pay all cash costs, and have cash remaining. However, this figure may be so low as to provide returns to the operator's labor, management, and capital which are far below market rates. Net farm income as defined here is approximately equal to taxable income as defined by the Internal Revenue Service.

Management income = net farm income minus interest on investment. This figure is a more accurate measure of the true "profit" of the operation. It represents what is left for the owner-manager's labor and management after paying all other factors of production at the market rates. It is assumed that the manager has full equity in his land and equipment. Hence, the "interest on investment" is not a cash cost, but represents an opportunity cost (what the capital could earn if invested elsewhere at market rates). If the operator owned less than 100 per cent of his business and therefore paid *cash* interest costs, both *net cash income* and the *net farm income* would be correspondingly lowered but *management income* would remain unchanged.

marizes the costs and returns and the net income figures from this cropping system. (See also appendix table A-11.) Since comparable net income figures are used for other plans throughout the report, they are briefly defined in the box above.

The results presented in table 9 show that the optimum cropping system alone provides sizable net cash and net farm incomes, and leaves a management income roughly comparable with salaries paid to professional farm managers on operations of this size and complexity. Although rice harvesting is assumed to be contracted in this study, the income figures likely could be raised somewhat by owning rice harvesting machinery, particularly in view of timeliness of harvest. Succeeding sections evaluate the income possibilities of reorganizing the resources of this cash crop farm into various types of farm feedlot programs.

OPTIMUM PLANS AND INCOME LEVELS USING SILAGE RATIONS

Table 10 summarizes the optimum farm organizations and income levels possible when a 1,500-head capacity feedlot, 13 air-tight silos and associated equipment are added to the cash crop farm. The results are presented for each of the six silage rations outlined earlier in table 7. Ration 5, using alfalfa haylage, oats-vetch haylage and barley, provides the highest income of the several plans, regardless of the income measure employed. Some milo is produced in each of the plans in table 10. In practice, a feeder would likely use the milo produced as

Table 10
COMPARISON OF OPTIMUM PLANS FOR THE SILAGE RATIONS*

Category	Crop, feed and livestock systems, and costs and returns for alternative plans					
	Ration 5	Ration 6	Ration 7	Ration 8	Ration 9	Ration 10
	acres					
Crops†						
Soil A (209 acres)	R–209	R–166 AH–43	R–209	R–166 CS–43	R–166 CW–43	R–166 CW–43
Soil B (335 acres)	AH–29 OVXM–44	AH–291 OVXM–44	AH–29 OVXM–44	R–26 AH–309	R–26 AH–309	R–26 AH–309
Soil C (430 acres)	R–100 AH–93 OVXM–214 M–23	R–143 OVXM–215 M–72	R–100 AH–93 OVXM–214 M–23	R–117 BXM–215 M–98	R–117 BXM–215 M–98	R–117 BXM–215 M–98
	pounds per head per day					
Components of ration						
Alfalfa haylage	16.0	16.0	16.0	16.0	16.0	16.0
Oat-vetch haylage	4.0	4.0	4.0	....	....	....
Corn silage	....	....	....	4.0	4.0	4.0
Barley	10.0	....	....	10.0	....	....
Milo	....	10.0	....	....	10.0	....
Corn	....	....	10.0	....	....	10.0
	cwt					
Feed buying						
Barley	54,000	.....	.....	50,775	.....	.....
Milo	.....	42,116	.....	.....	43,055	.....
Corn	.....	.....	54,000	.....	.....	54,000
	tons, haylage basis					
Alfalfa reconstituted	470	470	470	920	920	920
	cwt					
Feed selling						
Barley	.....	.....	.....	.....	3,225	3,225
Milo	10,153	.....	10,153	10,945	.....	10,945
	number purchased per month					
Cattle feeding						
Jan. - Dec.	300	300	300	300	300	300
	dollars					
Costs and returns						
Gross returns	940,076	912,558	942,722	924,975	906,405	933,584
Cash variable costs	751,256	729,052	775,556	752,184	738,510	783,095
Cash fixed costs	45,843	45,845	45,843	45,807	45,807	45,807
Depreciation	28,466	28,466	28,466	28,466	28,466	28,466
Interest on investment	33,675	33,675	33,675	33,675	33,675	33,675
	dollars					
Net income						
Net cash income	142,977	137,661	121,323	126,984	122,088	104,682
Net farm income	114,511	109,195	92,857	98,518	93,622	76,216
Management income	80,836	75,520	59,182	64,843	59,947	42,541

* Rations defined in table 7.
† R = rice, AH = alfalfa haylage, OVXM = oat-vetch, milo doublecropped, M = milo, CS = corn silage, BXM = barley, milo doublecropped.

part of the grain component in the ration fed. However, at the prices used in this study (buying and selling prices of $2.05 and $1.85 per cwt, respectively, for barley and $2.10 and $2.00 per cwt for milo) it is most profitable to use barley as the *purchased* grain. Of course, a shift in the milo-barley price relationship favoring milo could make it profitable to purchase milo rather than barley. Since comparable gains are obtained from silage rations using either barley or milo as the grain component, the choice of purchased grain depends on which provides the lower cost per unit of TDN.

The entire allotment of rice is included in each of the optimum programs in table 10. Rice is clearly the most profitable cash crop in the area, and in every plan it pays to raise rice as a cash crop and buy the major portion of the feed grains, rather than substituting feed grains for rice in the cropping system. Aside from rice, the rest of the acreage is devoted first to the forages required for the rations, the remainder to milo—the best remaining cash crop on C soils. However, the capacity of the 11 silos (two additional silos set aside for grain) is not sufficient to store enough forage at the end of the harvest seasons to carry all lots of cattle through the winter and early spring on the high forage rations. Hence, under plans 5, 6, or 7, 470 tons of alfalfa (haylage basis—the equivalent of about three silos capacity) are purchased and reconstituted during the winter months to carry the cattle until forage harvesting begins in the spring. Rations 8, 9, and 10 each require purchase and reconstitution of 920 tons of alfalfa (haylage basis—about 5½ silos capacity) because of the higher storage requirement for the corn silage included in these rations. Other alternatives to reconstituting alfalfa hay would be building additional storage capacity (the most economic would be building cheaper grain storage and using all 13 silos for silage), reducing the number of cattle fed, or switching to higher concentrate rations during the winter months. The latter alternative is evaluated on page 20.

As shown in table 10, it is most profitable to keep the feedlot filled to its practical capacity of 1,500 head year-around. To help reduce price risk, 300 head are bought and sold each month in order to be in the market year-around. The feeding period averages 150 days, with some cattle sorted out and sold earlier, some being held over until later in order to reach the desired finish. Under this system, 2.4 lots (3,600 head) are fed out and sold each year.

All of the rations considered increase the earning potential of the study farm considerably beyond that possible for a cash crop operation alone (compare tables 9 and 10). Note, however, that the earnings from the feedlot program are based on superior management as reflected in relatively high crop yields and livestock gains. Also, the livestock feeding program involves greater risk. Again, essentially a zero price margin (equal buying and selling prices averaging 25 cents per pound for 50 per cent good–50 per cent choice animals) is used throughout. However, since the finished animals are assumed to grade 25 per cent good–75 per cent choice, a slight positive margin of $0.375 per cwt actually exists for cattle fed on each of the ten rations studied. A more detailed appraisal of the critical price risk element in cattle feeding is made in the section starting on page 22.

OPTIMUM PLANS AND INCOME LEVELS USING NON-SILAGE RATIONS

Table 11 summarizes the optimum programs and income levels possible when a 1,500-head feedlot and feed mill for conventional ration feeding are superimposed on the study farm. The results are presented for the entire farm when cattle are

Table 11

COMPARISON OF OPTIMUM PLANS FOR THE NONSILAGE RATIONS*

Category	Crop, feed and livestock systems, and costs and returns for alternative plans			
	Ration 1	Ration 2	Ration 3	Ration 4
	acres			
Crops†				
Soil A (209)	R–209	R–209	R–209	R–190 A–19
Soil B (335)	R–100 A–67 BXM–168	R–100 A–90 BXM–145	R–80 A–255	A–335
Soil C (430)	BXM–215 M–215	BXM–215 M–215	R–20 BXM–215 M–195	R–119 BXM–215 M–96
	pounds per head per day			
Components of ration				
Barley Alfalfa Beet pulp	18.0 + U.C. supplement	13.0 2.0 6.0	12.0 5.7 4.9	9.8 8.0 4.2
	cwt			
Feed buying				
Barley	90,279	63,785	61,575	49,695
	cwt			
Feed selling				
Seel milo	22,106	21,140	14,350	10,885
	tons			
Sell alfalfa hay	402			
	number purchased per month			
Cattle feeding				
Jan.-Dec.	300	300	300	300
	dollars			
Costs and returns				
Gross returns	1,027,317	1,016,541	999,471	955,387
Cash variable costs	849,196	844,443	826,520	793,591
Cash fixed costs	48,491	52,735	52,783	52,817
Depreciation	19,040	20,238	20,238	20,238
Interest on investment	28,553	29,392	29,392	29,392
	dollars			
Net income				
Net cash income	129,631	119,363	120,168	108,980
Net farm income	110,591	99,125	99,930	88,742
Management income	82,038	69,733	70,538	59,350

* Rations defined in table 7.
† R = rice, A = alfalfa hay, BXM = barley, milo doublecropped, M = milo.

fed on each of the four grain-hay rations specified. The all-concentrate ration 1 is the most profitable nonsilage ration under the conditions specified. Rations 2 and 3, containing typical grain-hay ratios, rank about equal in income, but net approximately $12,000 less than the all-concentrate ration. Ration 4, with a high proportion of hay relative to concentrate, ranks somewhat lower in income potential—about $20,000 less than all-concentrate ration 1. The programming results also indicate that the all-concentrate ration alone produces greater income than any combination of the four rations shown in table 11. Despite the results presented here, some feeders still might prefer rations 2 or 3 over 1 because of the relatively short experience with all-concentrate rations, the possibility of cattle going off-feed, higher death losses and other factors. Considering these factors, the $12,000 separating these three rations may not solely determine a feeder's choice. Again, each of the cattle feeding plans (table 11) permit higher attainable incomes than a cash crop operation.

All of the plans in table 11 show milo sold and barley purchased. With the exception of ration 1, where barley is needed to provide enough fiber in the ration, the milo *produced* could be substituted for barley in the rations with negligible changes in income. However, after the home-produced supply of milo is fed, any additional grain *purchased* would be barley.

Table 11 shows that the optimum cropping system changes to include more alfalfa hay and less barley and milo as the type of ration shifts to a higher percentage of roughage. However, for none of the plans does it pay to attempt to produce all of the feed for the cattle finishing program. In every case it is more profitable to plant the entire rice allotment and purchase barley. Except for the plan using ration 1, where 67 acres of alfalfa hay are raised as a cash crop, the remaining plans produce just the alfalfa needed to supply the cattle feeding operation. In these cases, raising the alfalfa is a more profitable alternative than producing another cash crop and buying alfalfa.

OPTIMUM PLAN AND INCOME LEVEL USING A COMBINATION OF RATIONS

Tables 10 and 11 above indicate that rations 1 (all-concentrate) and 5 (alfalfa haylage, oats-vetch haylage and barley) are almost identical in earning power under the assumptions used. The effect of other shrink and grade assumptions are discussed later. The question arises as to whether some combination of forage and concentrate rations might provide higher income than either alone. Table 12, therefore, presents the plan representing the optimum choice from among all of the rations. The optimum plan uses a combination of the silage rations 5 and 6 (using both barley and milo) during the major portion of the year, with the all-concentrate ration being used for about one lot of cattle fed during the winter months October–February. The all-concentrate ration essentially replaces the reconstituted hay activity required to permit year-around feeding of the silage rations presented in table 10. The combination of rations in table 12 would be feasible in that the barley could be purchased as needed during the fall and winter, put in one of the silos, then crimped and fed as an all-concentrate ration, using the regular feeding setup available for the silage rations. However, the income incentive for introducing this new ration is slight, netting only about $2,000 more than ration 5 alone and only about $500 more than ration 1 alone. It is doubtful if feeders would be interested in introducing the complexity of feeding two completely different rations for these small bonuses.

Table 12

OPTIMUM PROGRAM AND INCOME LEVEL WITH COMBINATION OF HIGH FORAGE AND CONVENTIONAL RATIONS

Category	Crop	Acres
Crops		
Soil A	Rice	209
Soil B	Alfalfa haylage	310
	Oats-vetch × milo (doublecropped)	25
Soil C	Rice	100
	Alfalfa haylage	76
	Oats-vetch × milo (doublecropped)	215
	Milo	39
	cwt	
Feed buying		
Barley	47,846	
	Number purchased per month	Ration fed
Cattle feeding		
January	300	5
February	300	6
March–June	300	5
July	237	5
	63	6
August	300	6
September	300	5
October	300	1
November	16	1
	284	5
December	300	5
	dollars	
Costs and returns		
Gross return	923,694	
Cash variable costs	733,103	
Cash fixed costs	45,866	
Depreciation	28,466	
Interest on investment	33,675	
	dollars	
Net income		
Net cash income	144,725	
Net farm income	116,258	
Management income	82,583	

The main body of this report has concentrated on the question of optimum cattle finishing programs in farm feedlots, starting with feeder cattle in the 600-pound range. However, some operators, particularly those equipped to feed silage rations, may be interested in the possibilities of buying lighter animals and carrying them through to finished weights. Appendix B summarizes the results of such a program.

SENSITIVITY OF CATTLE FEEDING INCOME TO PRICE AND GAIN VARIABILITY

Assuming *average* price conditions, each of the farm plans that included cattle feeding increased income substantially over the cash crop operation. However, cattle feeding generally is considered quite risky. The following analysis indicates the variability in income from the cattle feeding operations resulting from variations in probably the two most critical factors influencing feeding profits—cattle prices and gains per day.

Profits from cattle feeding can be summarized as in equation (2) where:

$$(2) \qquad \pi = P_S W_S - P_B W_B - F - K$$

π = profit; P_B = buying price; P_S = selling price; W_B = initial weight; W_S = final weight after shrink; F = variable costs associated with feeding (feed, labor, etc.); and K = fixed or overhead costs (depreciation, taxes, etc.). Final weight after shrink equals initial weight plus total shrunk gain (G) in the feed lot ($W_S = W_B + G$). Substituting this expression in equation (2) and simplifying gives equation (3).

$$(3) \quad \pi = W_B (P_S - P_B) + (P_S G - F) - K$$

In the short run, fixed costs (K) can be ignored since they will remain constant whether cattle are fed or not; of course, in the long run they must be covered if the feeder is to remain in business. Hence, in the short run, cattle profits de-

pend on two factors: the increase (or decrease) in the value of the initial weight, $W_B (P_S - P_B)$; and the value of the gain (loss) over (under) feeding costs, $P_S G - F$. For any given lot of cattle on a specified ration, W_B, G and F can be assumed constant and the effect on profits of variation in the remaining price variables P_B and P_S assessed. Both the price *margin* $(P_S - P_B)$ and the *level* of prices (P_S) exert a strong impact on profits. Also, at *given* prices, variation in gains (G) sharply change the profit level.

Income variability resulting from fluctuations in cattle prices

Table 13 illustrates several aspects of the influence of cattle prices on the level and stability of income from the two most profitable farm plans derived earlier—those with cattle fed on rations 1 and 5, respectively. Variation in cattle prices would affect variability in income from the other livestock plans similarly.

The top portion of table 13 illustrates the effect of *price margin* $(P_S - P_B)$ on management income for rations 1 and 5,

Table 13

INFLUENCE OF PRICE MARGIN AND PRICE LEVEL ON FARM PROFITS FOR OPTIMUM FARM PLANS USING RATIONS 1 AND 5

Price relationships*			Optimum plan using ration 1		Optimum plan using ration 5	
Feeder cattle prices (P_B)	Slaughter cattle prices (P_S)	Price margin ($P_S - P_B$)	Management income	Deviation from average†	Management income	Deviation from average†
dollars per cwt			dollars	per cent	dollars	per cent
25.00	20.00	−5.00	−110,457	−235	−110,976	−237
25.00	22.00	−3.00	− 38,853	−147	− 33,332	−141
25.00	24.00	−1.00	32,751	− 60	34,312	− 58
25.00	26.00	1.00	104,319	27	101,920	26
25.00	28.00	3.00	175,923	115	169,564	110
25.00	30.00	5.00	247,527	202	237,208	193
20.00	20.00	0	10,971	− 87	20,193	− 75
22.50	22.50	0	46,467	− 43	50,260	− 38
25.00	25.00	0	82,038	0	80,836	0
27.50	27.50	0	117,459	43	111,362	38
30.00	30.00	0	152,955	87	141,890	75
20.00	20.33	0.33	9,531‡	.....	.....	.....
22.50	21.84	−0.66	9,531	.....	.....	.....
25.00	23.32	−1.65	9,531	.....	.....	.....
27.50	24.86	−2.64	9,531	.....	.....	.....
30.00	26.37	−3.63	9,531	.....	.....	.....
20.00	20.07	0.07	.....	.....	9,531‡	.....
22.50	21.67	−0.83	.....	.....	9,531	.....
25.00	23.27	−1.73	.....	.....	9,531	.....
27.50	24.86	−2.64	.....	.....	9,531	.....
30.00	26.46	−3.54	.....	.....	9,531	.....

* Feeder and slaughter prices based on 50–50 good-choice grade. Actual selling prices are $0.375 higher in each case because finished cattle assumed to grade 25–75 good-choice.

† Per cent deviation from average management income resulting from feeder and slaughter cattle prices of $25.00 per cwt for 50–50 good-choice ($81,982 and $80,833 for rations 1 and 5, respectively).

‡ Management income level possible from cash-crop operation of ranch.

at feeder cattle prices of $25.00 per cwt. A negative price margin of only $1.00 per cwt reduces management income for ration 1 from $82,038 (with $25.00 buying and selling prices) to $32,751—a drop of 60 per cent. A negative price margin of $3.00 per cwt results in a negative management income of $38,853—a drop of 147 per cent. The level of management income is equally sensitive to positive price margins. The variation in income from different cattle price margins is about the same for rations 1 and 5. While the *percentage* variation in income might be overemphasized by using *management* income as the standard for comparison, the *absolute* variation would be the same regardless of whether *net cash* or *net farm* income were used.

The second section of table 13 shows the effect on income of the *level* of cattle prices with a constant zero price margin. For example, ration 1 varies ± 87 per cent in management income as the level of buying and selling prices are varied simultaneously from $20.00–$30.00 per cwt. In all of these cases, the entire cattle feeding profit comes from the value of the gain over feed costs—the second source of profit in equation (3); the higher the price level, the higher the value of the gain. Since the price margin equals zero, the first source of profit contributes nothing to cattle feeding returns; i.e., $W_B (P_S - P_B) = 0$. Results for ration 5 are similar.

Hence, cattle feeding profits are highly sensitive to both *price margin* and the *level* of beef prices. The analysis provides evidence for the widely held conviction that cattle feeding is a high-risk business. Time devoted by a cattle feeder to studying market conditions and price trends usually is well spent; buying and selling cattle at the most favorable possible prices is probably the most important single aspect of his business.[6]

The last portion of table 13 answers this question: At various feeder cattle prices, what price margin is needed to "break even"? By break even is meant to provide a short-run management income as high as is possible by shutting down the feedlot and producing cash crops.[7] Table 13 shows that, at feeder cattle prices of $20.00, a slightly positive price margin is needed to break even. However, as feeder cattle prices rise, successively larger negative price margins can be sustained and still provide break-even profits. Referring again to equation (3), the higher level of prices permits the value of gain over feed costs (second source) to outweigh the negative price margin (first source).

The proceeding analysis shows that income associated with cattle feeding *can* be extremely variable depending on cattle price relationships. But do *actual* prices and profits show this degree of variability from year to year? Tables 14 and 15 show the management income which would have been derived annually from 1951–61 if the optimum plans with livestock using rations 1 and 5, respectively, had been employed in these years. Actual variations in both crop and livestock prices are reflected in the income figures shown. However, crop yields, production costs, and other variables are held constant at the levels assumed in the rest of the study. The top portion of each table shows the level and variability of management income if the cattle were purchased and sold on a monthly basis throughout the year. The lower portion of

[6] This analysis assumes that the feeder buys and sells his own cattle. A common alternative is custom feeding all or a part of the cattle for someone else who owns the cattle and takes the price risk. In this case, the returns to the feedlot operator will be related to the second source of profits—value of gain in relation to feed costs. For further information on custom feeding see King (1962) and Hopkin (1957).

[7] The fixed or overhead costs associated with cattle feeding still remain even if the lot is temporarily closed. The break-even margins of table 13 therefore reflect continuation of these costs.

Table

VARIATION IN COSTS, REVENUES AND MANAGEMENT
OVER PERIOD 1951–61, WITH MONTHLY

Costs and returns	1951	1952	1953	1954	1955	1956
	Monthly buying-					
	dollars					
Revenue						
Rice, 15,495 cwt	63,530	79,024	85,222	72,826	71,277	61,980
Milo, 22,106 cwt	66,318	80,687	67,423	57,476	50,844	56,370
Alfalfa, 402 ton	11,418	12,881	9,058	7,920	10,658	9,422
Livestock	1,181,347	1,131,025	807,970	800,900	765,638	704,602
Total revenue	1,322,613	1,303,617	969,673	939,122	898,417	832,374
Cost						
Feeder cattle	718,794	604,098	383,670	395,442	385,344	358,884
Buy barley, 90,279 cwt	267,386	286,116	247,963	208,862	198,519	198,920
Buy supplement, 540 ton	35,396	38,299	33,876	33,925	33,922	32,619
Other costs	188,690	188,690	188,690	188,690	188,690	188,690
Total costs	1,210,266	1,117,203	854,199	826,919	806,475	779,113
Closing-opening inventory	−15,540	−93,330	−55,560	2,340	−44,070	8,430
Management income (accrual basis)	96,807	93,084	59,914	114,543	47,872	61,691
(per cent of average)	(110)	(106)	(68)	(130)	(54)	(70)
Management income (cash basis)	112,347	186,414	115,474	112,203	91,942	53,261
(per cent of average)	(112)	(185)	(115)	(111)	(91)	(53)
	Seasonal buying-					
	dollars					
Revenue						
Milo, rice and alfalfa‡	141,266	172,592	161,703	138,222	132,779	127,772
Livestock	1,235,045	1,178,260	872,676	802,555	787,788	711,494
Total revenue	1,376,311	1,350,852	1,034,379	940,777	920,567	839,266
Cost						
Feeder cattle	730,647	626,940	366,444	399,060	343,197	364,068
Barley and supplement‡	302,782	324,415	281,839	242,787	232,441	231,539
Other costs	188,690	188,690	188,690	188,690	188,690	188,690
Total cost	1,222,119	1,140,045	836,973	830,537	764,328	784,297
Closing-opening inventory	−15,540	−93,330	−55,560	2,340	−44,070	8,430
Management income (accrual basis)	138,652	117,477	141,846	112,580	112,169	63,399
(per cent of average)	(140)	(118)	(143)	(114)	(113)	(64)
Management income (cash basis)	154,192	210,807	197,406	110,240	156,239	54,969
(per cent of average)	(138)	(189)	(177)	(99)	(140)	(49)

* Buy and sell 300 head monthly at actual prices.
† Fill lot twice a year; once in April, once in September; sell in January and August at actual prices.
‡ Not itemized since same as in upper section of table.

INCOME FROM OPTIMUM PLAN USING RATION 1
VERSUS SEASONAL BUYING AND SELLING

1957	1958	1959	1960	1961	1951–61 average	Optimum program	Coeff. of variation $C = \frac{s}{\bar{x}}(100)$
selling program*							
65,079	67,403	57,332	63,530	64,304	68,319	65,854	....
45,980	46,423	45,096	42,664	46,202	55,044	44,212	....
9,105	9,591	10,176	10,120	8,410	9,887	8,844	....
776,378	926,910	963,245	885,742	839,114	889,352	908,407	....
896,542	1,050,327	1,075,849	1,002,056	958,030	1,022,602	1,027,317	....
409,968	533,412	562,140	501,660	479,736	484,832	540,000	....
190,508	191,822	196,269	185,057	193,958	215,035	185,072	....
31,311	29,249	34,579	32,559	31,208	33,358	31,573	....
188,690	188,690	188,690	188,690	188,690	188,690	188,690	....
820,477	943,173	981,678	907,966	893,592	921,915	945,335	....
58,530	29,280	−18,240	−12,630	−2,070	−12,610	0	....
134,595	136,434	75,931	81,460	62,368	88,077	81,982	....
(153)	(155)	(86)	(92)	(71)	(100)	(93)	34.7
76,065	107,154	94,171	94,090	64,438	100,687	81,982	....
(76)	(106)	(94)	(93)	(64)	(100)	(81)	34.6
selling program†							
120,164	123,417	112,604	116,314	118,916	133,250	...	....
754,585	886,502	953,088	886,771	851,197	901,815		....
874,749	1,009,919	1,065,692	1,003,085	970,113	1,035,065		....
410,940	539,514	577,368	502,524	487,404	486,191		....
221,819	221,070	230,848	217,616	225,166	248,394		....
188,690	188,690	188,690	188,690	188,690	188,690		....
821,449	949,274	996,906	908,830	901,260	923,275	not applicable	....
58,530	29,280	−18,240	−12,630	−2,070	−12,610		....
111,830	89,925	50,546	81,625	66,783	99,180		....
(113)	(91)	(51)	(82)	(67)	(100)		30.8
53,300	60,645	68,786	94,255	68,853	111,790		....
(48)	(54)	(62)	(84)	(62)	(100)	...	52.4

the table shows the same data assuming that the cattle were purchased seasonally, one lot in the spring, another in the fall—probably a more usual practice for farm feedlots.

The data in tables 14 and 15 provide some interesting insights into price risks associated with cattle feeding. First, perhaps the most obvious observation is that cattle feeding may not be as risky due to price variation as the preceding analyses might indicate. In no year from 1951–61 would management income have been as low from cattle feedings as from cash crop farming alone (approximately $10,000). Second, there would have been little difference in either level or variability of management income between feeding ration 1 or ration 5. In part, this results from the fact that prices of purchased feeds did not fluctuate greatly from year to year (although there was a decline in the feed price level from 1951–61). Third, price variations from the cash crops were less important than cattle prices in influencing year-to-year income variability although again there was a general decline in cash crop prices over the 11-year period. Fourth, management income would have averaged roughly $10,000 per year higher from 1951–61 if cattle were bought and sold seasonally (spring and fall) rather than monthly. Fifth, variability in income would have been no higher from seasonal versus monthly buying and selling, providing income was reported on an *accrual* basis (i.e., taking into account changes in inventory values because of changes in the price level). For example, the coefficients of variation in annual management income from the monthly versus the seasonal programs were 34.7 versus 30.8, respectively, for ration 1 (table 14), and 30.8 versus 30.6, respectively, for ration 5 (table 15).[8] Sixth, if income were reported on a cash basis, the variability in income would have been appreciably higher from the seasonal program. The coefficients of variability in management income for monthly versus seasonal buying on a cash basis were 34.6 versus 52.4, respectively, for ration 1 (table 14), and 34.0 versus 51.3, respectively, for ration 5 (table 15). Thus, at least if income is to be reported on a cash basis, the argument for buying and selling cattle monthly to reduce income variability would appear sound. Seventh, because of changes in the level of farm prices, the income from the optimum programs derived in this report are slightly lower than the average income which could have been obtained from these same programs if employed over the past 11-year period. However, the levels of income from the optimum programs are somewhat higher than those possible in the past three years shown (1958–61).

Effect of gains per day on income and relative advantage of various rations

One of the most difficult variables to estimate in cattle feeding is the gain per day from a particular ration. The method used for estimating gains in this report was explained earlier; the same method was used for all rations in an attempt to maintain reasonable relationships among the gains from different rations. Despite this attempt, many feeders will not be able to achieve the feeding efficiencies and gains used in this report. Consequently, this section shows how the comparative advantage and the income levels associated with different rations change as gains per day vary.

As indicated earlier, rations 1 (all-concentrate) and 5 (alfalfa haylage, oats-vetch haylage, and barley) provide approximately equal management incomes at the assumed gain-per-day figures of 2.87 and 2.49, respectively.

[8] Coefficient of variation = (standard deviation ÷ mean) 100. The coefficient of variation is thus a comparative measure of the year-to-year variability in income from the various programs; it is computed from the indexes of management income from 1951–61 in tables 14 and 15.

Figure 1. **Combinations of Gains from Rations 1 and 5 which Yield Equivalent Management Incomes.**

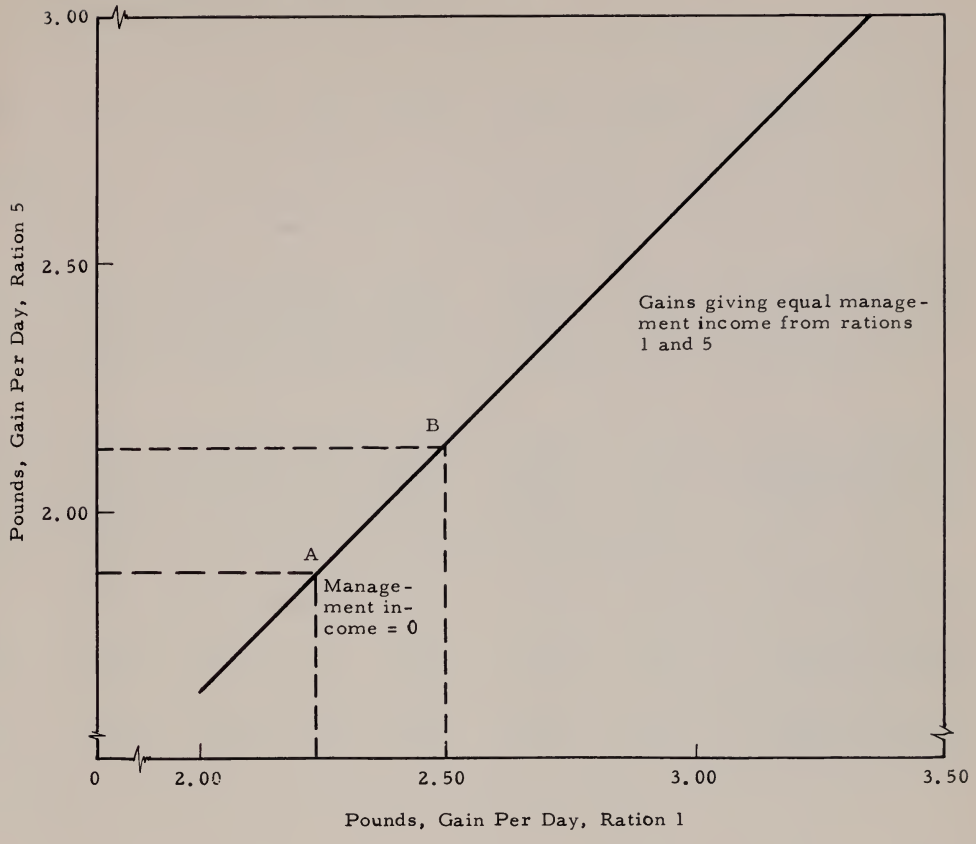


Figure 1 shows all combinations of the gains per day from rations 1 and 5 which provide the same management income. All-concentrate ration 1 has a profit advantage only if gains per day from it exceed by at least 0.37 pounds the daily gains from high-forage ration 5. For example, a 2.50-pound gain per day from ration 1 provides the same management income from the entire farm plan as a 2.13-pound gain per day from ration 5 (point B, figure 1.) Point A, figure 1, shows the gains per day required to provide a management income of zero from each of the two rations (at $25.00 per cwt buying and selling prices for cattle). In summary, for any combination of gains from rations 1 and 5 lying to the *left* of the dividing line in figure 1, it will be advantageous to feed ration 5; combinations of gains to the *right* of the dividing line favor ration 1.

Feeders equipped to feed only conventional hay-grain rations may be interested in a similar gain comparison with all-concentrate ration 1. Figure 2 provides the relevant "break-even" gains. Rations 2 and 3 would need to produce gains per day of nearly 0.1 pounds higher than ration 1 in order to provide comparable management incomes. For example, when ration 1 is assumed to give gains of 2.50 pounds per day, rations 2 and 3 must provide gains of 2.59 and 2.57, respectively, to produce the same profit. Gains from ration 4 can be about 0.1 pound

Table

VARIATION IN COSTS, REVENUES AND MANAGEMENT INCOME
1951–61, WITH MONTHLY VERSUS

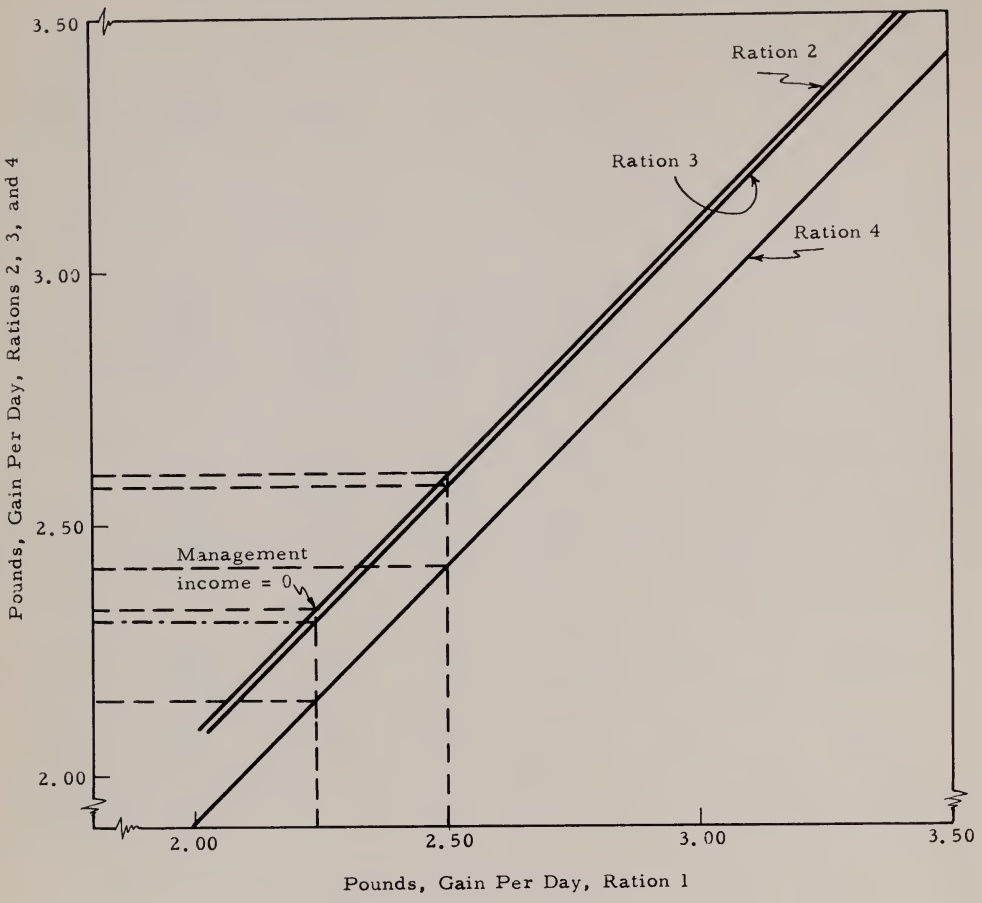
Costs and returns	1951	1952	1953	1954	1955	1956
						Monthly buying-
						dollars
Revenue						
Rice, 14,495 cwt	59,430	73,924	79,722	68,126	66,677	57,980
Milo, 10,153 cwt	30,459	37,058	30,967	26,398	23,352	25,890
Livestock	1,116,007	1,068,746	763,281	756,602	723,291	665,631
Total revenue	1,205,896	1,179,728	873,970	851,126	813,320	749,501
Cost						
Feeder cattle	718,794	604,098	383,670	395,442	385,344	358,884
Buy barley, 54,000 cwt	160,510	170,940	148,181	124,852	118,731	119,661
Buy alfalfa hay, 320 ton§	9,991	15,863	12,529	9,774	13,425	12,365
Other costs	199,601	199,601	199,601	199,601	199,601	199,601
Total cost	1,088,896	990,502	743,981	729,669	717,101	690,511
Closing-opening inventory	−15,540	−93,330	−55,560	2,340	−44,070	8,430
Management income (accrual basis)	101,460	95,896	74,429	123,797	52,149	67,420
(per cent of average)	(110)	(104)	(81)	(134)	(57)	(73)
Management income (cash basis)	117,000	189,226	129,989	121,457	96,219	58,990
(per cent of average)	(112)	(181)	(124)	(116)	(92)	(56)
						Seasonal buying-
						dollars
Revenue						
Rice and milo‡	89,889	110,982	110,689	94,524	90,029	83,870
Livestock	1,166,735	1,111,695	824,408	758,166	744,216	672,140
Total revenue	1,256,624	1,222,677	935,097	852,690	834,245	756,010
Cost						
Feeder cattle	730,647	626,940	366,444	399,060	343,197	364,068
Buy barley and alfalfa‡	170,501	186,803	160,710	134,626	132,156	132,026
Other costs	199,601	199,601	199,601	199,601	199,601	199,601
Total cost	1,100,749	1,013,344	726,755	733,287	674,954	695,695
Closing-opening inventory	−15,540	−93,330	−55,560	2,340	−44,070	8,430
Management income (accrual basis)	140,335	116,003	152,782	121,743	115,221	68,745
(per cent of average)	(137)	(113)	(149)	(119)	(113)	(67)
Management income (cash basis)	155,875	209,333	208,342	119,403	159,291	60,315
(per cent of average)	(136)	(182)	(181)	(104)	(138)	(52)

* Buy and sell 300 head monthly at actual prices.
† Fill lot twice a year; once in April, once in September, sell in January and August at actual prices.
‡ Not itemized since same as in upper section of table.
§ Includes a cost of $2.00 per ton to unbale, chop, add water, and put in silo.

:OM OPTIMUM PLAN USING RATION 5 OVER PERIOD
ASONAL BUYING AND SELLING

1957	1958	1959	1960	1961	1951–61 average	Optimum program	Coeff. of variation $C = \frac{s}{\bar{x}}(100)$
lling program*							
60,879	63,053	53,632	59,430	60,154	63,910	61,604	....
21,118	21,321	20,712	19,595	21,220	25,281	20,306	....
733,436	875,643	909,969	836,752	792,703	840,187	858,166	....
815,433	960,017	984,313	915,777	874,077	929,378	940,076	....
409,968	533,412	562,140	501,660	479,736	484,832	540,000	....
113,936	115,206	109,379	110,691	116,282	128,034	110,700	....
11,696	10,880	12,587	14,711	10,104	12,175	8,953	....
199,601	199,601	199,601	199,601	199,601	199,601	199,601	....
735,201	859,099	883,707	826,663	805,723	824,642	859,254	....
58,530	29,280	−18,240	−12,630	2,070	−12,610	0	....
138,762	130,198	82,365	76,484	70,424	92,126	80,822	....
(151)	(141)	(89)	(83)	(76)	(100)	(88)	30.8
80,232	100,918	100,606	89,114	68,354	104,736	80,822	....
(77)	(96)	(96)	(85)	(65)	(100)	(77)	34.0
elling program†							
81,997	84,374	74,344	79,025	81,374	89,191	...	....
712,850	837,470	900,373	837,724	804,117	851,808		....
794,847	921,844	974,717	916,749	885,491	940,999		....
410,940	539,514	577,368	502,524	487,404	486,191		....
125,632	126,086	121,966	125,402	126,386	140,209	not	.....
199,601	199,601	199,601	199,601	199,601	199,601	applicable	....
736,173	865,201	898,935	827,527	813,391	826,001		....
58,530	29,280	−18,240	−12,630	2,070	−12,610		....
117,204	85,923	57,542	76,592	74,170	102,388		....
(114)	(84)	(56)	(75)	(72)	(100)		30.6
58,674	56,643	75,782	89,222	72,100	114,998		....
(51)	(49)	(66)	(78)	(63)	(100)	...	51.3

Figure 2. **Comparison Gains from Rations 2, 3, and 4 which Yield the Same Management Income as Ration 1.**

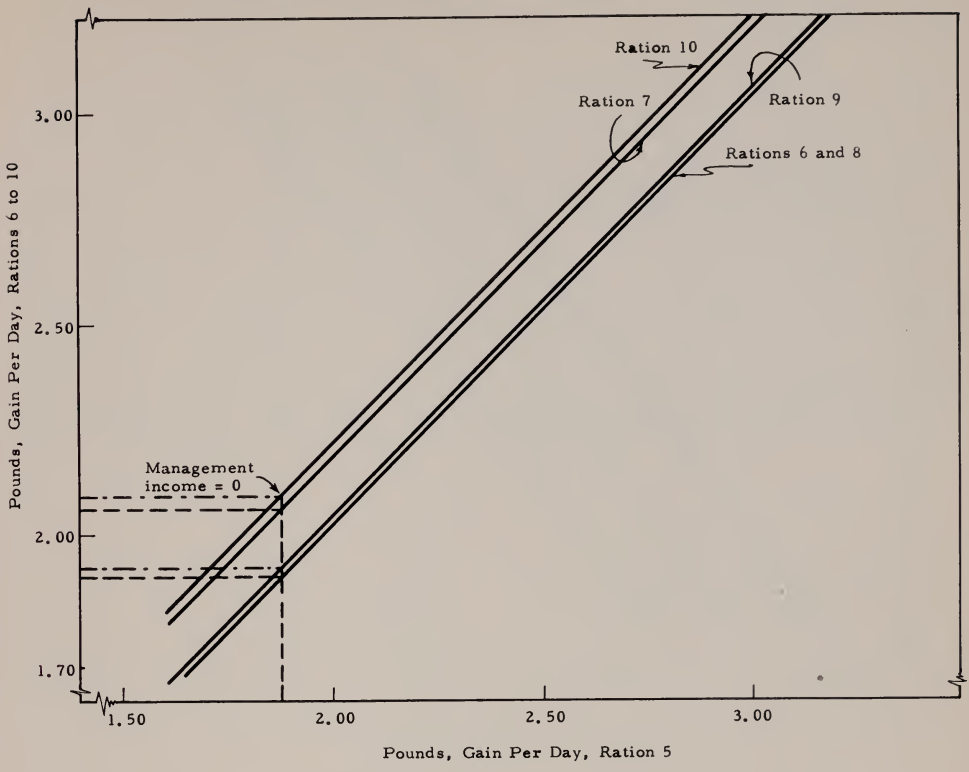


lower than from ration 1 and still provide comparable profits. Again, the relative advantage of the different rations will depend directly on the gains an individual feeder can *actually* obtain. For example, if a particular feeder has difficulty keeping cattle on feed using the all-concentrate ration, gains may drop to the point where he might more profitably feed ration 2 or 3.

Feeders organized to feed high silage rations would be interested in how individual silage rations 6–10 compare with the most profitable silage ration 5 under varying gain conditions. Figure 3 shows that each of the 5 rations 6–10 would have to provide greater gains per day than ration 5 in order to give comparable management income; the gain increases required vary from only 0.02 pounds per day for rations 6 and 8 to 0.21 pounds per day for ration 10.

Figure 4 shows more clearly the direct dependence of income level on gains per day from the ten rations studied. For example, if cattle on ration 3 gain 2.85 pounds per day, as assumed in this report, management income is approximately $70,000. However, if the feeder can obtain only a 2.5-pound average daily gain, management income drops to $25,000. If gains should fall to 2.0 pounds per

Figure 3. **Comparison Gains from Rations 6 to 10 which Yield the Same Management Income as Ration 5.**



day, a *loss* in management income of $40,000 would result. Similar comparisons can be made for the other rations shown in figure 4. It should be clear that only those individuals with the managerial capacity to maintain cattle on feed and gaining at better-than-average rates throughout the feeding period are apt to profit from cattle feeding.

In summary, level of income and choice of optimum ration both are quite sensitive to gains per day from the various rations. Gains even from a single ration can vary widely, as is evident from a comparison of feeding trials under different conditions of weight, quality, length of feeding period, feed additives, climate, and other factors. Based on his own evaluation of the gains obtainable from the various rations, a feeder can use figures 1, 2, 3, and 4 as aids in selecting the most profitable ration and likely level of income.

Effect of percentage shrink and final grade on income from various rations

It was stated earlier that this report may tend to overevaluate the high roughage rations because of the assumption of equal percentage shrink (3½ per cent) and final grade (75 per cent choice : 25 per cent good) for all rations considered. The effects of alternative assumptions are now considered.

The effect of added shrink is easily computed: for each additional 1 per cent shrink beyond the 3½ per cent assumption, management income drops by $8,000–$9,000. Hence, significant dif-

Figure 4. **Levels of Management Income Corresponding to Rates of Daily Gain for Each of Ten Rations.**

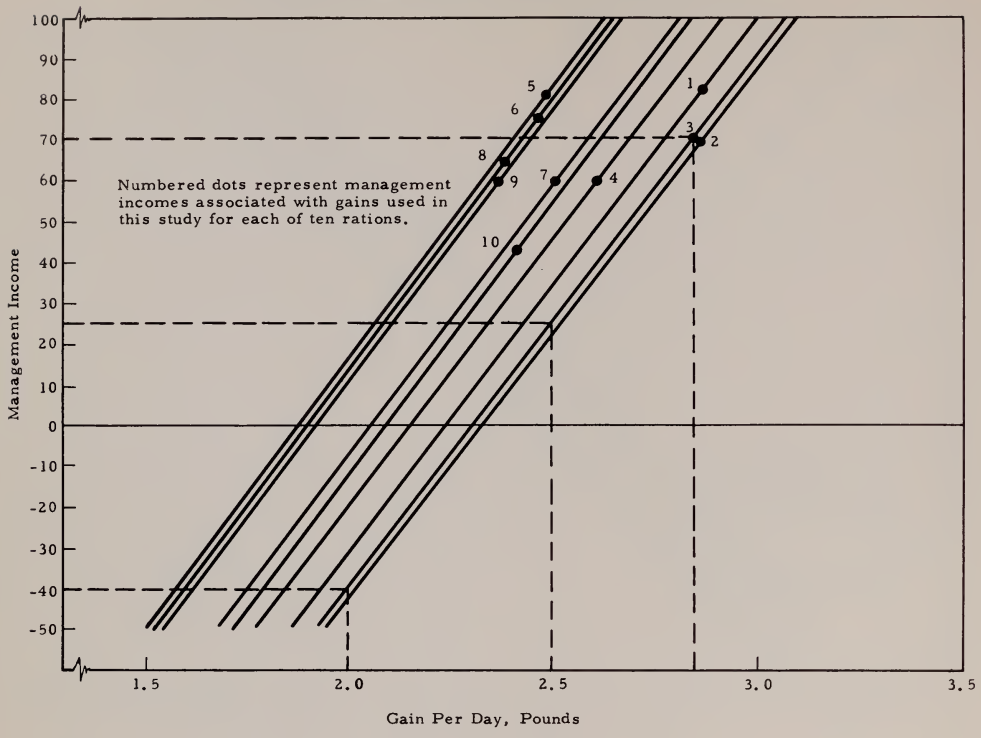
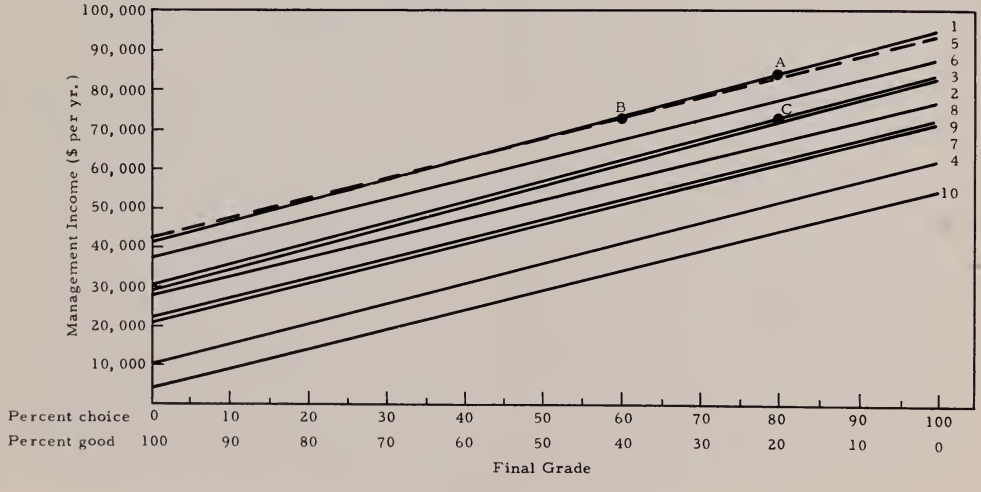


Figure 5. **Effect of Selling Grade on Management Income from Rations 1 to 10.**



ferences in shrink could substantially change comparative profits.

The effect of final grade on relative income from the various rations is more complex and is shown in figure 5. For example, suppose ration 1 (high concentrate) produces 80 per cent choice and 20 per cent good (point A, figure 5) while ration 5 (high forage ration) produces only 60 per cent choice and 40 per cent good (point B, figure 5). Using the assumed price differential of $1.50 per hundred between good and choice grade, ration 1 would then be about $10,000 more profitable than ration 5, rather than being equivalent. Under these same assumptions, if conventional ration 3 produced an 80:20 ratio of choice:good cattle (point C, figure 5) it would be as profitable as ration 5. Greater differences in grade would have more drastic consequences on relative net income. For example, if cattle on ration 1 grade 80:20 per cent choice:good and on ration 5 grade 20:80 per cent choice:good, the difference in management income increases to about $30,000. These are only illustrative examples. As more information becomes available the cattle feeder can formulate his own judgments of relative grades. Of course, this comparison will depend on grading standards used in the future and price differentials associated with grade.

APPENDIX A: BASIC DATA

Table A-1

ALFALFA HAY: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Stand establishment					
Plow	.67	1.00	3.32		4.32
Disc 2×	.60	.90	1.38		2.28
Disc and harrow 2×	.67	1.00	1.57		2.57
Landplane	.25	.38	1.10		1.48
Ridge and shape	.67	1.00	1.47		2.47
Harrow	.20	.30	.40		.70
Pre-irrigate‡	1.00	2.20		water, 4 acre–inches = $.50	2.70
Harrow	.20	.30	.40		.70
Plant	.40	.60	.96	seed, 20 lbs = $7.00	8.56
Total stand establishment.					25.78
Annual costs					
Irrigate 8×‡	5.00	11.00		water, 4 acre–ft = $6.00	17.00
Weed control	.10	.15	.11	weed control spray = $9.00	9.26
Fertilize	.20	.30	.23	nitrogen, 10 lbs; phosphorus, 80 lbs = $10.00	10.53
Insect control 2×	.20	.30	.22	Systox, 2 oz = $2.00	2.52
Mow 6×	1.80	2.70	2.43		5.13
Rake 6×	2.40	3.60	3.34		6.94
Bale 6×	1.14	1.71	2.58	wire @ $.75/ton = $6.00	10.29
Roadside 6× (3 men)	1.50	6.75	2.51		9.26
Total annual costs					70.93
Stand establishment prorated over 3-year life					8.59
Total variable costs					79.52

* Six cuttings, 8 ton per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.

† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.

‡ Two irrigators.

Source: Synthesized by authors from Farm Advisor cost studies and from costs on the study ranch.

Table A-2

ALFALFA HAYLAGE: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Stand establishment					
Plow	.67	1.00	3.32		4.32
Disc 2×	.60	.90	1.38		2.28
Disc and harrow 2×	.67	1.00	1.57		2.57
Landplane	.25	.38	1.10		1.48
Ridge and shape	.67	1.00	1.47		2.47
Harrow	.20	.30	.40		.70
Pre-irrigate‡	1.00	2.20		water, 4 acre–inches = $.50	2.70
Harrow	.20	.30	.40		.70
Plant	.40	.60	.96	seed, 20 lbs = $7.00	8.56
Total stand establishment					25.78
Annual cost					
Irrigate 8×‡	5.00	11.00		water, 4 acre–ft = $6.00	17.00
Weed control	.10	.15	.11	weed control spray = $9.00	9.26
Fertilize	.20	.30	.23	nitrogen, 10 lbs; phosphorus, 80 lbs = $10.00	10.53
Insect control 2×	.20	.30	.22	Systox, 2 oz = $2.00	2.52
Swath 7×	2.03	3.05	2.75		5.80
Chop 7×	1.00	1.50	6.35		7.85
Haul to silo and blow into silo	1.00	4.50	2.35		6.85
Total annual costs					59.81
Stand establishment prorated over 3-year life					8.59
Total variable costs					68.40

* 7 cuttings, 15 ton per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.

† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.

‡ 2 irrigators.

Source: Same as table A-1.

Table A-3

BARLEY: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 3×	.9	1.35	2.07		3.42
Harrow	.2	.30	.40		.70
Plant	.4	.60	.96	100 lbs seed @ $3.00/cwt = $3.00	4.56
Harrow	.2	.30	.40		.70
Weed spray	.1	.15	.11	weed control spray = $0.55	.81
Combine	..	...	...	contract @ $5.00/acre plus $.25/cwt = $12.50	12.50
Haul Blow into silo	.2	.30	.29		.59
					27.60

* 30 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-4

PINK BEANS: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 2×	.6	.90	1.38		2.28
Harrow	.2	.30	.40		.70
List	.3	.45	.36		.81
Pre-irrigate	1.0	2.20	....	water, 4 acre–inches @ $1.50/acre ft = $.50	2.70
Disc W/harrow 2×	1.33	2.00	3.14		5.14
Plant	.3	.45	.35	seed, 50 lbs @ 10¢/lb = $5.00	5.80
Cultivate 3×	.9	1.35	1.30		2.65
Irrigate 6×	3.0	6.60	....	water, 2 acre–ft = $3.00	9.60
Hoe	....	....	....	contract @ $7.50/acre	7.50
Pest control	....	....	....		5.00
Cut	....	....	....	contract @ $2.00/acre	2.00
Rake	....	....	....	contract @ $2.00/acre	2.00
Thresh	....	....	....	contract @ $1.00/cwt = $20.00/acre	20.00
Haul	....	....	....		2.00
Clean-store-sack	....	....	....	$.65/cwt	13.50
Total variable costs					86.00

* 20 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-5

CORN FOR GRAIN: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc with harrow 3×	2.00	3.00	4.71		7.71
Landplane	.25	.38	1.10		1.48
Fertilize	....	....	....	nitrogen, 150 lbs plus application $15.00 plus $1.25	16.25
Harrow	.20	.30	.40		.70
Plant	.30	.45	.38	seed, 14 lbs = $3.50	4.33
Irrigate 8×	4.00	8.80	....	water, 3 acre–ft = $4.50	13.30
Cultivate 3×	.90	1.35	1.30		2.65
Combine	....	....	....	contract = $15.00	15.00
Haul and blow into silo	.30	.45	.36		.81
Total variable costs					66.55

* 55 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators at $1.10 per hour.
Source: Same as table A-1.

Table A-6

CORN FOR SILAGE: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc with harrow 3×	2.00	3.00	4.71		7.71
Landplane	.25	.38	1.10		1.48
Fertilize	....	....	....	nitrogen, 150 lbs plus application = $15.00 plus $1.25	16.25
Harrow	.20	.30	.40		.70
Plant	.30	.45	.38	seed, 14 lbs = $3.50	4.33
Irrigate 8×	4.00	8.80	....	water, 3 acre–ft = $4.50	13.30
Cultivate 3×	.90	1.35	1.30		2.65
Chop	1.65	2.48	10.40		12.88
Haul and blow into silo	1.65	7.44	4.19		11.63
Total variable costs					75.25

* 25 tons per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming opreation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-7

MILO: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 3×	.90	1.35	2.07		3.42
Landplane	.25	.38	1.10		1.48
Fertilize	.20	.30	.23	100 lbs of nitrogen at $.10 = $10.00	10.53
Harrow	.20	.30	.40		.70
Plant	.30	.45	.38	12 lbs of seed at $.20 = $2.40	3.23
Cultivate 3×	.90	1.35	1.30		2.65
Irrigate 5×	2.50	5.50	....	water, 2 acre–ft = $3.00	8.50
Combine	....	....	....		10.00
Haul and blow into silo	.20	.30	.29		.59
Total variable costs					45.42

* 55 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-8

OATS-VETCH HAYLAGE: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 2×	.60	.90	1.38		2.28
Disc with harrow	.33	.50	.79		1.29
Plant	.40	.60	.96	seed, 80 lbs = $4.00	5.56
Fertilize	.20	.30	.23	nitrogen, 50 lbs; phosphorus at $.10 — $8.00	8.53
Swath	.66	1.00	1.10		2.10
Chop	.40	.60	2.52		3.12
Haul and blow into silo	.25	1.12	.60		1.72
Total variable costs					28.92

* 6 tons per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-9

RICE: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Tota
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 2×	.60	.90	1.38		2.28
Landplane 2×	.50	.76	2.20		2.96
Survey	....	....	....	$.60	.60
Check	.30	.45	1.01		1.46
Plow	.67	1.00	3.32		4.32
Disc	.30	.45	.69		1.14
Fertilize	....	....	....	90 lbs of nitrogen = $9.00, application = $3.00	12.00
Flood	.50	1.10	....		1.10
Plant	....	....	....	150 lbs of seed = $12.00, application = $1.50	13.50
Spray 2×	....	....	....	spray = $3.50, application = $2.50	6.00
Irrigate	2.00	4.40	....	water at $11.00	15.40
Drain and open checks	.10	.22	....		.22
Combine	....	....	....	$15.00	15.00
Bankout	....	....	....	$2.00 per ton	5.50
Haul	....	....	....	$2.00 per ton	5.50
Dry	....	....	....	$.35 per cwt	19.25
Total variable costs					110.55

* 55 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-10

SAFFLOWER: ESTIMATED ANNUAL VARIABLE PRODUCTION COSTS*

Operation	Hours per acre	Labor†	Fuel and repairs	Materials	Total
		dollars			dollars
Plow	.67	1.00	3.32		4.32
Disc 2×	.60	.90	1.38		2.28
Disc and harrow	.33	.50	.79		1.29
Fertilize	.20	.30	.29	50 lbs of nitrogen = $5.00	5.59
Plant	.40	.60	.96	45 lbs of seed at $.10 = $4.50	6.06
Combine	....	....	....		15.00
Haul to mill	....	....	....	$4.00 per ton	4.40
Total variable costs					38.94

* 22 cwt per acre yield. Annual fixed costs not allocated to individual crops, but charged against entire farming operation.
† Labor @ $1.50 per hour. Irrigators @ $1.10 per hour.
Source: Same as table A-1.

Table A-11

SUMMARY OF COSTS AND RETURNS FOR OPTIMUM CROP AND LIVESTOCK SYSTEMS

Costs and returns	Cash crop farm	Farm plans using different rations											
		Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6	Ration 7	Ration 8	Ration 9	Ration 10	Optimum comb. of rations	Finish calves on silage rations
	dollars												
Gross return													
Crops													
Rice	65,854	65,854	65,854	65,004	59,585	61,604	57,035	61,604	58,140	58,140	58,140	61,604	61,604
Alfalfa hay	31,020	8,844	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barley	5,966	.....	.....	.....	.....	.....	.....	.....	.....	5,966	5,966	.....	.....
Milo	30,100	44,212	42,280	28,700	21,770	20,306	.....	20,306	21,890	.....	21,890	.....	20,306
Crop total	132,940	118,910	108,134	93,704	81,355	81,910	57,035	81,910	80,030	64,106	85,996	61,604	81,910
Livestock*	.....	908,408	908,408	905,767	874,032	858,167	855,523	860,812	844,945	842,299	847,589	862,090	389,973
Total	132,940	1,027,317	1,016,541	999,471	955,387	940,076	912,558	942,722	924,975	906,405	933,585	923,694	471,883
Cash variable costs													
Crops													
Rice	33,305	33,305	33,305	33,197	32,500	32,765	32,165	32,765	32,306	32,306	32,306	32,765	32,765
Alfalfa hay	18,090	5,158	6,928	19,630	25,788	.....	.....	.....	.....	.....	.....	.....	.....
Alfalfa haylage	.....	.....	.....	.....	.....	24,357	21,667	24,357	19,884	19,884	19,884	24,550	24,357
Barley	5,160	9,484	8,892	5,160	5,160	.....	.....	.....	5,160	5,160	5,160	.....	.....
Milo	19,531	27,161	26,116	18,622	14,126	11,718	15,034	11,718	14,216	14,216	14,216	12,672	11,718
Corn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corn silage	.....	.....	.....	.....	.....	.....	.....	.....	3,236	3,236	3,236	.....	.....
Oats-vetch haylage	.....	.....	.....	.....	.....	6,995	7,022	6,995	.....	.....	.....	6,493	6,995
Crop total	76,086	75,108	75,242	76,609	77,574	75,835	75,888	75,835	74,802	74,802	74,802	76,480	75,835

Livestock													
Purchase cost	.....	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	143,150
Transportation in	.....	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776	2,061
Fuel and power	.....	4,266	4,266	4,266	4,266	2,591	2,591	2,591	2,591	2,591	2,591	2,591	2,591
Veterinary and medicine	.....	5,400	5,400	5,400	5,400	5,400	5,400	5,400	5,400	5,400	5,400	5,400	5,400
Purchased feed													
Barley	.....	185,072	130,759	126,229	101,875	110,700	.....	.....	104,089	.....	.....	98,084	55,350
Milo	.....	.....	.....	.....	.....	.....	88,444	.....	.....	90,416	.....	.....	.....
Corn	.....	.....	.....	.....	.....	.....	.....	135,000	.....	.....	135,000	.....	.....
Alfalfa hay†	.....	.....	.....	.....	.....	8,954	8,954	8,954	17,526	17,526	17,526	.....	8,954
Supplement	.....	31,574	81,000	66,240	56,700	.....	.....	.....	.....	.....	.....	2,771	.....
Livestock total	.....	774,088	769,201	749,911	716,017	675,420	653,164	699,720	677,382	663,708	708,293	656,623	217,506
Total	76,086	849,196	844,443	826,520	793,591	751,256	729,052	775,556	752,184	738,510	783,095	733,103	293,341
Cash fixed costs													
Crop foreman	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Livestock labor	.....	9,000‡	13,000	13,000	13,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Repairs on livestock facilities	.....	1,136	1,136	1,136	1,136	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Interest on operating capital§	2,663	23,629	23,633	23,681	23,715	23,654	23,656	23,654	23,618	23,618	23,618	23,677	17,062
Property tax on cattle	.....	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
Taxes and insurance	4,523	5,976‡	6,216	6,216	6,216	7,439	7,439	7,439	7,439	7,439	7,439	7,439	7,439
Total	12,186	48,491	52,735	52,783	52,817	45,843	45,845	45,843	45,807	45,807	45,807	45,866	39,252
Net cash income	44,668	129,631	119,363	120,168	108,980	142,977	137,661	121,323	126,984	122,088	104,682	144,725	139,290
Depreciation	11,669	19,040	20,238	20,238	20,238	28,466	28,466	28,466	28,466	28,466	28,466	28,466	28,466
Net farm income	32,999	110,591	99,125	99,930	88,742	114,511	109,194	92,856	98,517	93,621	76,216	116,258	110,824
Interest on investment	23,468	28,553	29,392	29,392	29,392	33,675	33,675	33,675	33,675	33,675	33,675	33,675	33,675
Management income	9,531	82,038	69,733	70,538	59,350	80,836	75,519	59,182	64,843	59,947	42,541	82,584	77,149

* 3½ per cent shrink on final weight.
† Includes a cost of $2.00 per ton to unbale, chop, add water and blow into silo.
‡ Costs for hay handling equipment and for labor to handle hay are deleted.
§ 7 per cent for six months of crop total variable cost plus 7 per cent of average value of 1,500 head of cattle for one year.
Note: Occasional discrepancy in final digit from rounding original computations to nearest dollar.

APPENDIX B: OPTIMUM PLAN USING SILAGE RATIONS TO CARRY CALVES TO FINISH WEIGHT

In this program, summarized in table B-1, calves are purchased at 350 pounds and fed for six months (176 days) on a daily ration consisting of 16.0 pounds of alfalfa haylage, 4.0 pounds of oats-vetch haylage, and 1.0 pounds of barley. Using equation (1) in the text, gains during this period are estimated at 1.42 pounds per day. At the end of this six-month period the cattle, averaging 600 pounds, are placed on finishing ration 5 (see text) for the regular finishing program of five months. Over the total 11-month feeding period, the cattle gain an average of 1.91 pounds per day and are sold (after shrink) at 940 pounds per head. The calves are purchased at four-month intervals, with the lot being filled immediately with calves as each lot of finished cattle is sold. Under this program an average of 1,636 head are bought and sold each year.

The optimum cropping system for this program is the same as for the plan in which cattle are finished year-around on ration 5 (compare tables 10 and B-1). However, less grain is purchased in the calf finishing program because of the lower grain requirement for the lighter cattle. Management income for this plan is only about $4,000 less than for ration 5. Furthermore, because of the lower purchase weight and efficient gain on light cattle, calf feeding is usually considered less risky than feeding somewhat heavier cattle. For example, cash variable costs (including cost of feeder cattle) are only $293,340 in table B-1, compared with $751,256 for ration 5, table 10; of course, gross income also is much lower in the calf feeding program. Although risk on calves is generally considered lower than on heavier cattle, it should be recognized that the calves are carried for 11 months rather than 5 months, and that price risk increases with the length of feeding period. Yet, with cattle purchased three times during the year, this added price risk element may not be serious.

An important qualification of this plan (table B-1) is the assumption that 350-pound good-choice feeder calves can be purchased for the same price ($25.00 per cwt) as 600-pound good-choice feeders. A comparison of annual average prices over a ten-year period at Stockton for good-choice steers indicates that 350-pound calves are usually priced higher than 600-pound feeders. At feeder prices of $25.00 per cwt, calf prices would appear to average about $27.00 per cwt. If so, management income on the calf feeding plan would be reduced by $11,452 to $65,684. Still, this program would be more profitable than finishing programs for silage rations 7 to 10 (table 10).

In summary, feeders interested in a somewhat lower risk, less capital intensive silage operation may find a calf feeding program attractive. Once again, gains per day actually obtained, particularly during the growing period from 350-600 pounds, would have an important influence on the optimum choice of feeding system. With the data presented in tables B-1 and A-11, the interested reader can budget out costs and returns based on different gain assumptions.

Table B-1

OPTIMUM PLAN USING SILAGE RATIONS TO CARRY CALVES TO FINISH WEIGHT

Category	Crop	Acres
Crop		
Soil A	Rice	209
Soil B	Alfalfa haylage	291
	Oats-vetch × milo (doublecropped)	44
Soil C	Rice	100
	Alfalfa haylage	93
	Oats-vetch × milo (doublecropped)	214
	Milo	23
	cwt	
Feed buying		
Barley	27,000	
	tons, haylage basis	
Alfalfa reconstituted	470	
	cwt	
Feed selling		
Milo	10,153	
Cattle feeding	Purchase 500 350-lb calves at four-month intervals. Feed calves for 6 months on daily ration of 16.0 lbs alfalfa haylage, 4.0 lbs oats-vetch haylage and 1.0 lbs barley. Switch to ration 5 for 5 months finishing period. Total feeding period = 11 months. Fill lot immediately as finished cattle sold. Average of 1,636 head bought and sold each year.	
	dollars	
Costs and returns		
Gross returns	471,883	
Cash variable costs	293,340	
Cash fixed costs	39,252	
Depreciation	28,466	
Interest on investment	33,675	
	dollars	
Net income		
Net cash income	139,291	
Net farm income	110,824	
Management income	77,149	

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LITERATURE CITED

Garrett, W. H., J. H. Meyer and G. P. Lofgreen

1959. The comparative energy requirements of sheep and cattle for maintenance and gain. J. Animal Sci. **18**(2).

Heady, E. O. and W. E. Candler

1958. Linear programming methods. Iowa State Coll. Press.

Hopkins, John A.

1957. Cattle feeding in California—a study of feedlot finishing. Bank of America, Econ. Dept., San Francisco.

King, Gordon A.

1962. Economics of scale in large commercial feedlots. U.C. Giannini Fdn. Res. Rept. 251.

Morrison, Frank B.

1949. Feeds and feeding. The Morrison Publ. Co., Ithaca, N.Y.

Sitton, Gordon R.

1958. Sacramento Valley rice farms, 1. Organization, costs, and returns. U.C. Giannini Fdn. Mimeo Rept. 207.

Wyckoff, J. B.

1961. Marketing beef cattle and calves in Washington. Wash. Agr. Exp. Sta. Cir. 384.

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